THE

ELECTRICAL REVIEW.

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THE

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WIRELESS TRANSMISSION OF ELECTRIC POWER.

WE give in another column a description of the Tesla system of electric power transmission through natural media, which, if it accomplishes all that it professes to do, will be truly an epoch-making invention. We are not aware whether Tesla was the first to conceive the brilliant idea of transmitting electric power through the rarefied strata of the atmosphere, but he certainly appears to be the first who has designed and constructed apparatus intended to realise the idea in practice.

It has long been known that the resistance of air to the passage of electricity gradually decreases to a certain minimum, and then increases again possibly to infinity as an absolute vacuum is approached. Since the pressure of the atmosphere decreases as we ascend, a stratum of minimum conductivity must at length be reached. We must, therefore, have a tolerably good conductor covering the whole surface of the earth, insulated on one side by perhaps the most perfect of all insulators—an absolute vacuum; and on the other side by an immense thickness of air at pressures gradually increasing to atmospheric pressure. It must be good news to electrical engineers to learn that such a natural insulated conductor is available to transmit electricity to the uttermost parts of the earth. Tesla proposes to use these rarefied upper strata of the atmosphere as his outgoing lead, the earth being employed as the return. He has constructed a transformer capable of generating alternating currents at pressures amounting to millions of volts, and he discharges these high pressure currents in the rarefied air from electrodes supported on balloons. The currents pass through the rarefied air to another electrode similarly suspended at the receiving station, where they are transformed down to the original pressure and utilised for producing light, generating power, &c. One terminal of the long coil of each transformer is put to earth, the other terminal being connected to the elevated electrode.

In criticising Tesla's scheme from the practical standpoint, many insuperable objections to it appear to present themselves, though we must admit that so little is known of the resistance of rarefied air to such high tension alternating currents as Tesla makes use of, that only approximate conclusions can be arrived at. If Tesla has made new discoveries as to the behaviour of air towards such currents, we must await the publication of practical achievements by the new system. Meantime, many considerations appear to indicate that the scheme is chimerical.

In the first place, is a stratum of sufficient conductivity to be found at an accessible height in the atmosphere? Schultz measured the pressure required to pass a discharge through a Geissler tube by the length of the spark in a parallel circuit. His tube was 90 mm. in length and 10 mm. in diameter. He found that the pressure which gave the maximum conductivity was about 0·1 mm., and that the

parallel spark at this pressure was about one-thousandth of the length of the tube. Now, in order to reach a stratum of the atmosphere at a pressure of 0·1 mm., it would be necessary to ascend to a height of about 30 miles; and even if this were possible, the specific resistance of the conductor would only be reduced to one-thousandth that of air, though this would be partly compensated for by its exceedingly great cross section.

Tesla, as we gather from the description, does not appear to have any intention of trying to reach the 30-mile limit. He asserts that he has found that he can send with his apparatus currents up to any amount and to any distance through air at moderate rarefactions, or even at atmospheric pressure. These assertions do not agree with the recent experiments of Prof. Trowbridge [Electrical Review, Vol. 42, p. 135], who found that, with a pressure of 1,200,000 volts, he could only obtain a spark of 4 feet in length in air at ordinary pressure. He also concluded from his experiments that the spark length in air was strictly proportional to the pressure which produced it. Tesla's millions of volts, judging by these experiments, would only send an electric current through distances measured by feet. It is true that Trowbridge did not employ the rapidly alternating currents which Tesla has experimented with, and this, we admit, may make a great difference in results. The wonderful way in which the high frequency currents, discovered some years ago by Tesla, will pass through considerable thicknesses of the best insulators, makes it probable that, with high frequency currents, the resistance of air may be considerably reduced.

But high frequency currents are highly unsuitable for the transmission of power, except in synchronised circuits, owing to the high percentage of wattless current. Tesla does not therefore limit himself to extremely high frequency, though it is necessary to use considerable frequencies in his transformers to obtain the necessary great increase of pressure.

Since Tesla does not intend to raise his electrodes to the impracticable height of the stratum of minimum conductivity, he has to face the fact that the conductivity of the air in a vertical direction will be greater than that in the horizontal direction along which he wishes to send his current. His current will, therefore, in the first place, go up, and if it ultimately reaches the desired place, it will not be by the shortest distance between the two given points. It seems more probable that the electricity discharged will be lost in the *ewigkeit*.

Should a serious attempt be made to carry out Tesla's scheme, the effect on the meteoric conditions of the atmosphere will have to be considered. The charging of the upper regions of the atmosphere with enormous quantities of electricity at millions of volts will not be free from danger to the lives of the earth's inhabitants, not to speak of minor inconveniences. It might be expected to make our hair literally stand on end, and to send our lighter possessions flying into the empyrean; though we might, it is true, get rid of a few things, such as fogs, that would never be missed.

Notwithstanding our objections to Tesla's remarkable invention, we wish him success in his experiments in this comparatively unexplored field. The science of electricity will benefit by his discoveries, even if they do not lead to the great revolution in telodynamic transmission which he expects.

Few, if any, modern investigators can equal Tesla in originality and soaring scientific imagination. These qualities in Tesla have already brought to light, high frequency currents, with their wonderful properties and applications, and his present investigations may yet lead to results equally remarkable. But we do not think his latest invention will bring about an immediate change in our present methods of transmitting electric power.

THE BURNING QUESTION.

After reading the widely circulated criticisms of Mr. T. W. Baker upon the Shoreditch combined destructor and electricity undertaking, and the replies which he has drawn from Mr. H. E. Kershaw, the chairman of the Lighting Committee, and from the Vestry Clerk, we are almost tempted to call this a *boiling* question.

Mr. Baker, on his side, has made, under great difficulties, what appears to be a faulty analysis of the lately published accounts of the Vestry; though on some points his case is by no means weak.

This has unfortunately been met by replies from the officials in question which are distinctly lacking in good taste. Mr. Kershaw represents Mr. Baker in the light of a disappointed contractor, and thereby seeks to destroy that gentleman's case by importing mere prejudice. He also talks about cheap notoriety, which seems hardly becoming in Mr. Kershaw. The most interesting part of the reply is the promise of accounts which can be understood and relied upon, which are to be forthcoming very shortly. We have waited patiently for these accounts a long time, and therefore regard this as good news.

Dr. Mansfield Robinson, the Vestry Clerk, also seems to have been much disturbed by Mr. Baker's criticisms, to judge from his remarks about "amateur adventurers."

Whatever scheme Mr. Baker may have submitted to the Shoreditch Vestry, when offers were publicly invited, we hardly think it correct on the part of the officials who received that scheme to refer to it at this date in the manner adopted by these two gentlemen; and we are, moreover, convinced that public interests will not be served by such an unreasonable display of temper over what appears to be serious criticism. Whatever usefulness dust may have in the production of light, its value is not to be demonstrated by throwing it in people's eyes.

For our part we prefer to await the reports to the end of June before attempting to make any exhaustive analysis. But as we are anxious that the promised reports shall give as much information as possible, we venture to call attention to one or two points that are worthy of discussion.

As 18,842 tons were burned in nine months in the 12 cells when the destructor was working six days a week, it would appear that the amount burned per cell per 24 hours was about 6·7 tons, and the total refuse burned per week was 483 tons.

The actual wages paid according to the report were as follows:—

15 stokers at 32s. 8d. per week.
6 top men at 28s. per week.
4 labourers at 24s. per week.

The labour of firing with coal on Sundays seems to have

been performed by the same stokers, so it may be fair to deduct one-seventh of their wages, and reckon them at, say, 28s. per week.

Then we have a total of, say, £34 4s. for wages for working the destructors, or, say, approximately 1s. 5d. per ton. This is very high as compared with other destructors unprovided with the expensive "labour-saving" machinery adopted at Shoreditch. At many destructors of the simplest character, the cost on the eight hours' system is under 10d. per ton for labour.

The cost of management also appears very high at Shoreditch, as there is one foreman and three chargemen under him; also there is a weighing clerk, with three cleaners and a fitter, who appear to be constantly employed about the destructor; and their united wages over and above those of the stokers come to £13 16s. per week, or, say, nearly 7d. per ton burned. Therefore, the cost of labour and management for the destructor is not far short of 2s. per ton. No wonder that the Blackheath and Greenwich Company, with Mr. Kershaw on their board, decided to be off their bargain for refuse burning.

But we find that Mr. Kershaw, now so impatient of criticism, stated at the opening ceremony on June 28th, 1897, that the cost of burning, interest on capital, wear and tear of plant, and wages, actually came to 1s. 2d. per ton. It would be interesting to know how he arrived at that figure.

Mr. Baker, in his letter, calls attention to this question of cost of burning, but instead of taking the cost over a week, as we have done, he takes it over the whole 12 months; and he is met with the reply that the burning has only been going on for nine months, while the expenses have been going on for 12 months. Why three months should be necessary for slow-firing at Shoreditch, when one month is found sufficient everywhere else, it is not easy to see.

Again, the Vestry officials dismiss the idea of a depreciation fund, because under their borrowing powers they have to repay the cost of the whole plant in 42 years; the machinery and cells being reckoned at 15 years, and the buildings, &c., at correspondingly longer periods.

This seems to be an equitable arrangement, provided that the whole plant is handed over in perfect working order at the end of the 15 years. To do this it is necessary to repair out of revenue, and there can be little doubt that the cells will have to be entirely rebuilt in less than 15 years; and probably the boiler and other plant will have to be renewed. A ten years' life is much more commonly reckoned upon for such plant. The whole cost of that renewal should hardly be allowed to fall upon the revenue of the fifteenth year. On the contrary, we think that at least 7½ per cent. on the cost of the furnaces, boilers, and machinery should be taken out of each year's revenue, notwithstanding the fact that the capital is borrowed and has got to be repaid: otherwise a further sum will probably have to be borrowed at the end of the 15 years for the purpose of re-building.

We find that the total units produced in the nine months were 491,107, of which, probably, 100,000 units were produced from coal (reckoning 7 lbs. coal per unit). The enormous amount of 156,725 units was used on the works in driving lifts, tipping-waggons and fans, and in distribution losses. 50,807 units were lost altogether. In other words, 207,532 units were non-productive, or 40 per cent. of the total generated.

Again, we hope to find some information in the forthcoming report respecting the Halpin thermal storage, which, it seems, is not now in operation. It is much to be regretted if this apparatus is to be held a failure owing to some defect in construction; particularly as so much attention was directed to its use at the commencement.

We have, for a considerable time past, been convinced that destructors are a necessity from a sanitary point of view; that they cannot be properly worked except at a high temperature; that the heat produced ought to be utilised for as large a proportion of the 24 hours' working day as is practicable; that under favourable conditions it is advisable to place them alongside electricity stations for the purpose of utilising the available heat during the hours of lighting; and that considerable economy would result from saving in fuel, stokers' wages, and management. But we are being forced to the conclusion that there may be defects in the design and construction of the steam raising plant at Shoreditch, and that the undertaking has been given an undue and premature prominence which may seriously re-act against such combinations.

This is the more to be regretted, inasmuch that all the criticism might have been disarmed, and all the difficulties avoided by a frank recognition of these defects and a prompt application of remedies.

This plant is again referred to in the Vestry Clerk's report as the pioneer undertaking. Fortunately for such enterprises this is, as we have often pointed out, not correct, and the value of combined plants is already being quietly demonstrated elsewhere, while the Shoreditch results are still the subject of furious invective and inconclusive discussion.

The sooner a clear and satisfactory statement of the facts is forthcoming, the better.

The Interference of Electric Tramways with Submarine Telegraphs.

Mr. Trotter's recent report on the disturbance of the signals received on the submarine cables at the Cape by the action of the electrical tramways in Cape Town is fresh in the recollection of our readers. It will be remembered that he concluded that the only effectual way to deal with the difficulty was to obtain an "earth" at some place at a considerable distance from the source of the disturbance, and he proposed to lay a short cable several miles straight out into the sea, having its conductor connected to the exposed sheathing at the extreme end. The conductor of this cable would then provide the only working earth for the cable station, and no perceptible E.M.F. could be produced between this earth and the main body of the ocean by the action of the tramway electric system. We imagine that an arrangement of several submarine cables working through their receiving instruments into a common cable connected to earth might afford some pretty problems, but possibly the small capacity of the earthing cable might make its effect on the signals negligible. We see from a contemporary that the same difficulty is occurring at Marseilles, where the Algerian cables are landed. The French authorities appear to have overlooked Mr. Trotter's able report on the question as it arose at Cape Town, since it is stated that at Marseilles "has been installed for the first time an important electric network of conductors in a great cable landing station." And again: "The experience at Marseilles on so large a scale has been met with, one may say, for the first time." Their solution of the difficulty is identical with Mr. Trotter's, viz., to obtain a working earth from a short cable laid out to sea, but has the peculiarity of being *toute nouvelle*.

ELECTRIC LIGHTING COSTS: BLACKPOOL WINTER GARDENS COMPANY, LIMITED.

Annual Report of Electrical Engineer.

We have received, through the medium of a local paper, a copy of the report of the electrical engineer of the Blackpool Winter Gardens, with the comments of the chairman thereon.

A most remarkable production—remarkable not only for the financial results it gives, but for the impression it conveys to an outsider of pronounced hostility to the Corporation's electricity department. We do not remember to have come across many instances before of the owners of a private plant publishing details of their running costs. As a rule, persons or companies, when dissatisfied with the charges for supply from the public mains, put down their own plant, and keep to themselves the results of their enterprise. At any rate, it is unusual for them to publish these results, with virulent comments in the local press, probably because there is seldom little or any occasion for self-congratulation. More often, indeed, do they find themselves, after a while, obliged to revert to their original source of supply, lamenting lost capital and personal prestige. But not so here. It has been, apparently, sufficient that the plant has been working a full year and the result ascertained, so that everybody may know how easy it is for a private company to generate electricity at a cost of a trifle over 1d. per unit, whilst a Corporation, presumably through mismanagement or rapaciousness cannot, or do not, generate and sell it to the public at less than 5d. per unit.

The publication of the accurate running costs of electrical plant by private owners is to be highly commended in the interests of the profession; but such publication, with sneering references to local supply authorities, is strongly to be deprecated. We should, indeed, feel sorry if we thought that electrical engineers would readily lend themselves to this practice when occasion offered, and we rejoice to have reason to believe that they would not. Quarrels, such as this one appears to be, had much better be fought out privately. There is no necessity whatever for electrical Montagues and Capulets to cross lances in public on matters of this kind.

For ourselves, we have no interest in the quarrel. Our desire is to test the accuracy of figures which are published officially, and which will, if found to be correct, be undoubtedly taken as the lowest recorded price at which electricity has been generated, under ordinary conditions, in this country, and as such will be accepted by the electrical profession, in particular, and the public, in general.

In the report under review, the engineer lays especial stress on the extraordinary saving effected by the company in putting down their own plant, over the cost of taking their supply from the Corporation's mains. On the assumption that the Corporation's average charge would have been 5d. per unit—the actual charges are, as a matter of fact, 8d. per unit for the first hour and 2d. afterwards—he asserts that the saving to the company, for the 12 months, has been not less than £2,240. As if this might be too much for outsiders to credit, the chairman of the company comes forward and endorses the statement, declaring that he has carefully gone through the figures and checked the whole of the invoices and wages sheets. "On this point," he continues, "he has been most particular, as the results obtained so far exceeded his most sanguine expectations that he felt it absolutely necessary to be positively assured of their accuracy before publication."

We omit the other comments in the report and give below the figures as they are published.

Analysis of Accounts for the Year Ended June 30th, 1898.

	£	s.	d.
Capital expenditure on plant	15 000	5	
Revenue from supply gardens at 5d.	4,061	5	
" tenants at 5d.	189	1	11
Total revenue	4,250	6	11
Total costs	1,100	15	3
Gross profit	3,149	11	8
Interest on capital at 4 per cent. on £15,000	600	0	0
Depreciation 2 per cent. on £15,000	300	0	0
Financial result (saving on Corporation charges) ...	2,249	11	8
Number of units supplied	203,095		

Analysis of Costs

Generation:	£	per unit.
Coal	501 ...	·59
Oil, waste, water, &c.	87 ...	·10
Wages	240 ...	·28
Repairs	75 ...	·09
Works' costs	£903 ...	1·06
General costs:		
Rent, rates, &c	100 ...	·11
Management, stationery, &c	96 ...	·13
Total costs	£1,099 ...	·130

Financial result:

Saving on what the Corporation would charge on their prices ... ... £2,249 11s. 8d.

	Corporation.	Winter Gardens.
Capital expended	£85,413	£15,000
Revenue from supply	£12,827	£4,250
Number of units supplied ...	707,965	203,095

Analysis of Costs.

Coal	·88	·59
Oil, &c.	·27	·10
Wages	·50	·28
Repairs	·38	·09
	2·03	1·06

Works' Costs.

Rent, rates, and taxes	·08	·11
Management	·31	·13
	2·42	1·30

Ratio of Revenue to Capital.

15 per cent.	28 per cent.

Units Supplied per £ Capital.

8·2	13·5

Frankly, we must confess our faith in the accuracy of these figures is not so great as the chairman's. For one thing, they are not complete; for another, they seem to attempt to prove too much. The capacity of the plant should have been stated, and also the maximum demand, the number of lamps installed, and the approximate hours of lighting. It should have been stated, too, whether the consumption was estimated from the switchboard readings, or taken from an accurate meter. The consumption charged for appears to us to be abnormal, and it is difficult to conceive how 203,095 units can have been consumed in an establishment, the major portion of which is not supposed to be used for more than five months of the year. On this point of output everything depends, and as the means of checking it are not given, the results may well be questioned. Depreciation seems to us to be fixed at an altogether too low a sum, viz., 2 per cent. It should be put at not less than 4 per cent. to be satisfactory. Then we notice one or two trifling errors, which further tend to shake confidence in the veracity of the figures. In one place the total costs are shown as £1,110 15s. 3d., and in another as £1,099 (why not have equalised them?); while, according to our calculation, 203,095 units at 5d. come to £4,231 2s. 11d., not £4,250 6s. 11d. as given. The fuel account is low, though unexceptionable; but the stores item, including water, £87, creates suspicion, unless the efficieney of the plant is above the average. The most astonishing item in the analysis, however, is that against management, stationery, &c., £96. Surely this is an error; for the engineer of a station with an output of over 200,000 units per annum cannot be content to receive a salary equal to that of a switchboard attendant at an ordinary central station? Perhaps our engineer resides on the premises, and has "everything found"?

With these points questionable, we cannot but regard the figures with distrust, nor can we accept them as proving the statement that such a saving has been effected, or that the company can claim to have generated electricity at 1½d. per unit. Pending their confirmation by independent persons, we are of the opinion that they are unreliable, and should be taken *cum grano salis*. We regret, therefore, we are unable to look upon the report as it stands as little better than so much waste paper.

THE HATCH ACCUMULATOR.

An interesting accumulator, known as the Hatch, which may claim, in a sense, to be of the solid type, is about to be introduced to the English market. Although new to electrical men on this side of the Atlantic, the accumulator, of which we are speaking, has achieved considerable success in the United States.

The improvement effected in the Hatch cell may be properly termed a mechanical one. It is in the direction of making the elements solid with a considerable reduction in weight. This is attained, however, without much compression of the active mass, and it is claimed that a high degree of porosity is maintained while the active agent is completely exposed to the electrolyte. It will be seen from the following description that one of the notable features of the cell is the absence of a metal grid.

In constructing the Hatch element, a porous plate of unglazed earthenware is used, having square receptacles on its face side, and grooves on its reverse side, as shown in figs. 1 and 2.

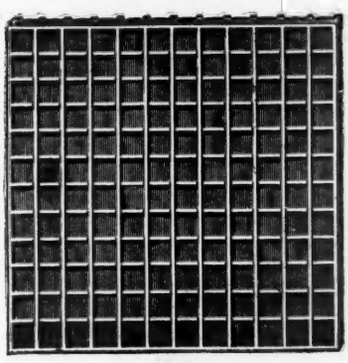


Fig. 1.

To the face side of each plate is applied the lead oxide or active agent, filling the mass $\frac{1}{8}$ inch above the surface of the plates, so as to secure an agglomeration with the electrode during the forming process.

The plates thus loaded with the active agent are then placed together, back to back, with the grooves crossed.

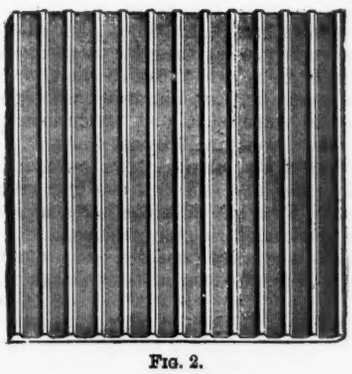


Fig. 2.

This forms one couple, positive and negative, of the element.

A series of these couples are then assembled, as shown in fig. 3, to form the complete element, as many couples being associated as is necessary for the required capacity.

The sides of this element thus assembled are flanked with a rigid support plate of glass, or similar material, and then encircled with heavy rubber bands, as shown.

The electrodes are then applied in any desired form, but ordinarily are used in the form of lead sheets, interleaved with the active material, as illustrated.

It is claimed that the oxides are permanently locked up, while the porosity of the entire mass is secured so that it will remain porous during the work, as the elasticity of the element allows for the expansion and contraction of the active material without closing the pores of its own mass.

Provision is also made for free circulation of the electrolyte between the plates, at the same time allowing a free escape of the gases formed by electrolysis.

Fig. 3.

A set of Hatch accumulators has been erected in this country at Messrs. Niblett & Sutherland's works under the supervision of Mr. Hatch and Mr. Hathaway, who is concerned in the commercial development of the accumulator in this country. This battery is to be tried on the London cabs, and at a future time we shall have something more to say on the cell and its uses.

MR. PREECE'S CIVIL ENGINEERS' ADDRESS.

Whilst Mr. Preece's Presidential Address to the Institution of Civil Engineers on Tuesday last could not fail to be of great interest in many respects to electrical men, we agree with Sir Frederick Bramwell in taking exception to some of his remarks.

It appears to us that if it is thought necessary to enter into names at all, very great care should be taken in an address of this character not to mention some only at the expense of others equally eminent. With every desire to do full justice to the brothers Edwin and Latimer Clark, as we think we have done in our obituary notice of the latter in our last issue, it seems to us that the following statement is far too sweeping. It runs thus:—"The mechanical construction of the telegraphs of this country was designed by our late distinguished member, Edwin Clark, and his brother, Latimer Clark." If Mr. Preece had contented himself with the remark that he had pleasant recollections of working under the Clarks on behalf of the Electric Telegraph Company, and that he felt sure that they would always be remembered amongst the leading pioneers of land and submarine telegraphy, we should have agreed *in toto*; but with the statement as it stands, we cannot. Surely Mr. Preece must recognise that the Magnetic Telegraph Company for instance —though he did not happen to be connected with it—was an extremely formidable competitor of the "Electric,"* that their system was established on entirely different principles to that of the "Electric," and that their officials had a great deal to do with the evolution of telegraphy, land and submarine, and with what Mr. Preece calls "the mechanical construction of the telegraphs of this country."

But if it does not suit Mr. Preece to recognise this, we think

* In proof of this, we may remark that the "Magnetic" Company paid higher dividends than the "Electric."

our readers will agree that under the head of telegraphy his reference to the pioneering of the submarine branch of the subject was scarcely in proportion to the notice he gave to land telegraphs. We have an allusion to the "*Limnoria terebrans* having invaded our channels," and to the introduction of brass tape in submarine cables. We also have the truism that "no one has done more than Lord Kelvin to improve the electrical working of submarine cables." But surely in an address to civil engineers (of all people) it might have been worth while to make a corresponding reference to the engineering work connected with the construction, laying, and repairing of our ocean cables in which far vaster sums of money are involved than in anything above alluded to, in land telegraphy or otherwise. These are matters that come well within the scope of what is termed "*heavy* engineering" which cannot be said of aerial telegraphs to anything like the same extent. It is true that Mr. Preece's connection with *ocean* telegraphy is of a somewhat slight description; but we should not have supposed that this would prevent his dealing with the subject for the purposes of an address in an adequate manner, especially as herein lies the main point of contact with the profession of civil engineering. Surely Mr. Preece does not venture to contend that this ground was covered by the shallow water lines of the Electric Telegraph Company. As he went out of his way to mention names, we will now add a few facts that may be useful to bear in mind.

1. Messrs. Crampton and Wollaston were the first to lay a cable across an open channel —from England to France.

2. Sir Charles Bright was the first to demonstrate the possibility of laying a continuous length of some 2,000 miles of cable across an open ocean—the Atlantic—in a two to three-mile depth.

3. Sir Samuel Canning was the first to demonstrate the possibility of recovering a cable from such a depth.

Some of these pioneers have now passed away; but are not the above facts quite as well worth recording as anything that Mr. Preece saw fit to mention in connection with pioneer telegraphy? We trust that Mr. Preece's way of putting things will not lead astray the shining lights of the Institution; but we fear that presidential addresses are always liable to be taken as gospel.

We imagine that many will take exception to the President's wholesale condemnation of limited liability companies. There are, of course, black sheep in every flock; but we should like to know where telegraphy, in its broadest—international and colonial—sense would have been without them. The same question might be asked regarding railways and other branches of engineering industry; but we have contented ourselves with an example that should appeal to Mr. Preece.

On the other hand, we have pleasure in giving every support to all Mr. Preece's words of wisdom regarding technical education, the need of reform in its methods, and the class of men to whom it should be entrusted. Mr. Preece's opinions on this subject are probably the most sensible that have ever been uttered: they are, in fact, just what we should have expected from him.

In cordially agreeing with Mr. Preece's eulogy of the inventive genius of another of his former chiefs in the Electric Telegraph Company, the late Cromwell Varley, we should add that we consider his brother, Samuel Alfred Varley, has done quite as much for telegraphy and electrical science generally, though in a less prominent way.

It seems to us that where anyone represents a certain branch of engineering, he should be more than ever careful what he says in connection with that subject when addressing his fellow members, many of whom are unacquainted with it.

Finally, we may remark that, in certain portions of his address, it seems to us that Mr. Preece forgot that he was not addressing a juvenile, or mixed, audience—say, at the Royal Institution.

AUTOCAR MOTORS.

We illustrate below a continuous current series-wound motor, specially designed by Messrs. Veale & Co., Limited, of St. Austell, for propelling electrically-driven vehicles by means of direct chain gearing off both ends of the spindle. The chief features of the design, apart from the general compactness, are lightness in weight, great starting power, high efficiency, and the small space occupied in height as compared with the diameter of the armature—the latter being of great importance when the motor should be required to be fixed directly under the floorboard of the vehicle, which is very often the case. Another feature is the ease with which the armature and field coils may be withdrawn for the purpose of repairing should occasion require. The field magnets are of cast-steel of the four-pole type, having two

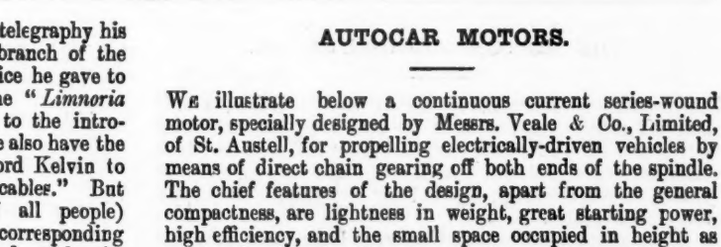


Fig. 1.

Fig. 2.

exciting coils wound on circular cores. The armature is of the slotted ring Gramme wound type, having a double winding and two commutators, which, by means of a suitable controlling switch, may be worked in series or parallel—the latter arrangement generally being necessary for starting the vehicle or steep hill climbing. The motors are usually fitted with two sets of carbon brushes to both commutators, which have specially designed holders; the cross parallel grouping armature connections being wound on the back of each commutator. The motor, fig. 1, as illustrated, is designed to work at 95 volts 30 amperes at 600 revolutions per minute; weight, 290 lbs.; armature, 9 inches diameter.

Messrs. Veale & Co., Limited, have four standard sizes of the above type machine, and their machines are giving satisfaction. The firm has just completed an order for six machines of various outputs for one client.

Fig. 2 shows a separate armature, and a motor fitted with perforated metal guards showing the armature withdrawn.

ELECTRICITY IN AGRICULTURE.

In the *Electrotechnische Zeitschrift* of October 20th, p. 697, two successful installations of electric ploughing are described. According to the figures given, the cost of electric ploughing compares very favourably with the cost of steam ploughing (at least in Germany).

In the first case described, a farm (Dahlwitz by name) is supplied with its whole light and power from a central station of 60 H.P. For lighting, an alternating current at 1,000 volts is used, the voltage being transformed down at the place where it is consumed; while for driving pumps, threshing machines, ploughs, and other machinery, a direct

current of 500 volts is utilised. Herr v. Treskow, the owner of Dahlwitz, estimates the total consumption of energy to be 111,800 H.P.-hours per annum, about half of which is used to work the electric plough; 250 acres are ploughed per annum, and the cost, according to Treskow's calculation, is 31s. 3d. per acre, which is considerably cheaper than steam ploughing.

Experiments on the royal demesnes, Sillium and Cloeden, have led to similar results. A communication by the Minister of Agriculture to the members of the Prussian House of Delegates, puts the cost of electric ploughing in heavy soil, with deep cultivation, at 45s. to 55s. per acre, and that of steam ploughing at 85s. per acre. Besides this reduction in the cost of ploughing, it is to be remembered that power required for other purposes on the farm is reduced in cost to almost the same extent.

The system employed at Dahlwitz is the so-called single machine system, and was installed by F. Brutschke, of Charlottenburg. The mechanical apparatus was made by the firm of Borsig. The 500-volt direct current is carried by aerial lines between the fields; and at suitable places on the poles are couplings for connecting up the movable cables which lead the current to the motor. Cable drums are not used, the redundant length of cable being laid by hand in large coils on two carriers fixed on the motor waggon. The motor waggon contains a motor which drives the winding drums, and which can also be coupled to the driving wheels of the waggon, to give it the necessary advance at the end of each traverse of the plough. The rope (15 mm. diameter) runs off one drum in the direction of motion of the plough to the other end of the field where it passes round a loose pulley and then back to the second winding drum on the motor waggon. The rope winds itself on to one drum, and off the other till the plough comes to the end of the furrow. Of course, during the approach of the plough, the tension on the loose pulley is double that on the rope, and the waggon on which the pulley is mounted must be very firmly anchored. This is done by means of an anchor with four prongs, which bury themselves deep in the ground when the tension comes on the rope. While the plough is on its return journey in the direction of the motor waggon, the loose pulley is almost entirely free from tension, and advantage is taken of this to pull the anchor out of the ground by screw gearing driven from the loose pulley. A second coupling then throws the loose pulley into gear with a small drum, which winds on an anchored rope, and causes the pulley waggon to advance a step into position for the next furrow. The attendant then disengages the coupling, and allows the main anchor to fall down. As in steam ploughing, the motor waggon is advanced at the end of each traverse by coupling the motor to the driving wheels. Three men are required to attend to the plough. The depth of the furrow was 20 to 25 cm., the width about 130 cm., and the speed of ploughing 1 metre per second. The consumption of current in the central station varied from 30 to 50 amperes at the 500 volts.

GAS v. ELECTRIC TRACTION.

There can be no question of the efficiency of gas-propelled tramcars, nor probably of their cheaper first cost as compared with an electrical system, but the gas-propelled car has certain disadvantages from which the electrical car is free.

Smell, no doubt, is one disadvantage. The exhaust of a gas engine is somewhat malodorous, but it may be retorted that a public which has literally swallowed the horse, or much of what the horse has finished with, will scarcely choke at a gas engine. But the horse has hitherto been a sort of Hobson's choice, and it is matter of common observation that the public, which will uncomplainingly put up with anything third rate, so long as there is nothing better, will no longer put up even with the second rate in the presence and possibility of the first rate. Again, the vital question with trams is that of rapid acceleration, and though the gas engine may have its constantly running fly-wheel to help the starting, there is not that large reserve of power to be drawn upon that there is with electrical driving, where a starting car can be drawn on the fly-wheels at the central station. We do not believe the gas car is seriously vibratory, but we think on that score, also, the electrical tramcar will show a better record. Personally, we would welcome the gas tramway in preference to the horse system.

Gas does at any rate promise a better speed, and we might rely upon its influence to put a stop, by the doubling of lines, to the disgraceful stoppages which characterise suburban London tramways at the passing turnouts. A journey by a London tramcar seems to be an interminable series of waitings for the passing car which seems never to come. Better traction would attract so many more passengers, that it can scarcely be believed that the single line tramway would endure on any busy service. As regards gas traction, if the smell could be done away with, it would be an excellent system in London for ordinary 'bus traffic. The gas engine is not so odorous as the benzine motor, and the question of compression is so small, that we wonder the British Gas Traction Company have never attempted to run a line of London omnibuses on their system. Gas traction has entered the field too late for its own good, and at a perhaps awkward time for electrical working. By its low first cost it appeals to the timid man, who is afraid to face the cost of electrical work, and it may delay the highest class of work in some instances.

Gas traction has been before the public nearly 20 years, the first patent which came under the writer's notice being taken out in Melbourne in the early eighties, but it is only quite recently that any serious effort has been made to push it. Electrical traction has made such rapid progress in America that it is bound to remain the first system everywhere. Yet there is a field for the gas system which may well occupy a good many years to fill, and for temporary work it is unequalled owing to the ease with which it can be installed wherever there is a public gas supply. But there must be a gas supply. The poorer gas of the producer would not stow into a sufficiently small space to be usefully employed. Were this found practicable gas traction would indeed become a formidable rival of electrical traction on a much wider field. But electricity will always command the principal position if by reason only for speed and acceleration.

THE BREAKDOWN AT BRIGHTON.

During the past few weeks there has been quite an epidemic of failures of public and private lighting, including both gas and electricity. The latest, and, we hope, the final of this series of extinctions occurred at Brighton on Thursday, October 20th.

The reliable information to hand on the matter is but brief. A short circuit occurred in the armature of a 220-kw. dynamo, and the minimum current cut-outs of all the other dynamos in the parallel operated thus automatically switching off the whole station. In the absence of full details, including the sequence of events, any discussion of the matter must necessarily be speculative and somewhat unprofitable.

Our contemporary, the *Electrician*, of October 28th contains some editorial notes on the subject, and the issue of the same paper of November 4th contains two letters, in all three cases suggestions as to the probable cause of the *minimum* cut-outs operating on a short circuit are made, and advice how to avoid such mishaps in future are freely offered. We imagine Mr. Wright must feel very much as Mark Twain felt when everybody offered him different remedies for his cold, and we have no doubt that as in the case of the famous humourist, the result of accepting all the advice would be disastrous. The *Electrician* says: "One can easily conceive that if excess current cut-outs or fuses were used in series with each dynamo, a certain sluggishness in the minimum cut-out, in the case of an armature short circuit, *would* (italics are ours) blow the excess current cut-outs of all the other machines." If the word *might* is substituted for *would*, we agree; but it by no means necessarily follows. It is also stated that as it was essential that the current from the dynamos must have been enormously reduced in order that the cut-outs could operate, the explanation can only be sought in the dynamos themselves.

In the absence of details it is no use being dogmatic, and it is just possible that at the dynamo is not the only place where the fault may be found. That the cut-out of the injured machine should not operate until the speed had been reduced on all the others sufficiently to cut them out appears improbable, but supposing this was the case, as suggested by our contemporary, the substitution of return current cut-outs would not improve matters, as these would be equally liable to stick.

Mr. Wm. C. P. Tapper, whose letter appears in the *Electrician* of November 4th, seems perfectly satisfied that non-return cut-outs and separate excitation are not only absolutely essential, but afford *complete* security against the class of breakdown under consideration. To say that any form of automatic device affords *complete* security, is to make a statement which very few experienced central station engineer, we venture to say, would care to endorse.

The suggestion of the other correspondent, Mr. Arnold Philip, raises a somewhat important and not improbable point. He suggests the possibility of the shunt circuit of the damaged dynamo having been opened either accidentally or *intentionally* (italics ours) in order to prevent a complete burn out of the armature. Of course, half a minute's thought would show the danger of this, and several other things that may be done without due consideration. It by no means follows that the men in charge of a station, when called upon to act in emergency, are always equal to the occasion, and a very simple blunder may produce most serious results. We do not suggest that any blundering has occurred, but if in the excitement some wrong move had been made, it would not have been an isolated case, and considerable nerve and presence of mind is essential at such times. Another possible solution, and one which we do not remember having seen in print, is that the increased demand upon the remaining dynamos, due to short circuit of the faulty one, naturally caused a sudden rise in current in all the cut-out coils. This sudden rise would naturally induce a momentary current in the solid iron core of the cut-out in the opposite direction, thus partially or wholly depolarising it for an instant, when all the cut-outs would at once operate. This could be easily proved, and if found to be the cause, a laminated core would remove the trouble.

Whatever may have been the cause, we hope the Brighton engineers will publish the facts, as it is only by actual experience that many difficulties are discovered and overcome, and any information which will help others to avoid similar accidents will be of great and universal advantage to the electric lighting industry.

CORRESPONDENCE.

Wire and Cable Testing.

In reply to the request of Mr. C. F. Ashton-Pryke for an explanation of the apparent improvement in the insulation of a cable under test by the ohmmeter, it seems to me that it may be due to one or both of two things. One explanation may be that the low reading at first obtained is due to the electrification of the dielectric (and this will specially be the case if the insulation is a compound and not India-rubber), although the fact of the needle remaining constant for nearly a minute tells against this theory.

A better explanation is that the low insulation is due to dampness on the surface of the ends or "trims" of the cable; this at first causes leakage, but by the current from the ohmmeter generator, the moisture is gradually evaporated, and the insulation consequently improved.

This trouble may easily be overcome by pouring clean boiling paraffin wax all over the trims and back along the cable for about 6 inches. If the phenomena is still present after this, the cable should be properly tested with the reflecting galvanometer and high voltage current, as the ohmmeter is at best a rough and ready instrument for getting at the approximate insulation of a cable.

F. Pooley.

Dumoulin Copper Depositing Process.

With reference to my letter in your issue of the 28th ult., and "F. A.'s" letter in your issue of the 4th inst., it is true that Alexander Watt believed at one time in burnishing with yielding surfaces, and I discussed the matter with him both before he took out his patent of 1891, and not long before his death. I looked into his matters carefully, as he wished me to interest myself financially in his inventions, but he had to admit that he had no practical experience of the manufacture of copper tubes, using soft burnishers. Speaking from memory, I think he claimed that the use of the soft burnishers prevented the formation of bubbles of hydrogen gas on the surface of the tubes. Mr. Watt was, however, not the first to patent this, as there was a patent taken out practically for the same thing some time before 1891. If "F. A." is interested in the matter, I will turn up my papers and give him the date and number of the patent. The conclusion I have come to is, that the action of a hard burnisher is to mechanically press out the small particles of copper that are deposited into tiny filaments or ribbons, and thus to give the copper article a fibrous character instead of a crystalline character. If you test a piece of Elmore tube parallel to the line of the fibre and across the fibre you will find a considerable difference in the strength, a strong argument in favour of this theory.

F.

Your correspondent "A. F.'s" discovery of Watt's patent does undoubtedly constitute a good anticipation of the so-called Dumoulin process, but there are earlier anticipations, the Elmore's patent, especially in No. 15,831, of 1886, claiming burnishers, pressers, rubbers, &c., and if these softer burnishers possessed any advantages over agate one would have expected the patentees to have used them.

Your correspondent has hit the nail very squarely on the head in classing the so-called impregnator a "rubber," that is also the term used in Elmore's earlier patent.

Wm. Brown.

[Correspondence on this subject is now closed.—Eds. Elec. Rev.]

The Position of Draughtsmen.

The truth of the statement made by "A.I.E.E." in your last issue "that the premium pupil is ousting not only draughtsmen but many other classes of engineers," is, I think, open to question. If by "ousting" your correspondent means filling positions which draughtsmen would no doubt prefer to their own I quite agree with him, but this is hardly the general meaning of the word. A man cannot be ousted from a position he has never filled.

As the profession of electrical engineering advances there is a continually increasing demand for men who have undergone a first-class technical training, and this demand is most successfully met by the premium pupil. If he has supplemented his experience of from three to five years in the shops by a three years' course at some well-known technical college, he will probably have obtained the best professional education it is possible to get.

A draughtsman's education on the contrary is confined to one or two years in one or two of the many different shops, and the rest of his time is spent in copying old drawings and adapting them to meet special cases. He has, as a rule, no thorough grasp of the principles underlying the profession and is rarely conversant with any but the most elementary of engineering problems and calculations. He is therefore quite unqualified for the higher branches of the profession, and can no more hope to compete with a man who has undergone a special training than the chemist can with the doctor whose prescriptions he dispenses.

The positions occupied by men who have been premium pupils are usually those for which a draughtsman is not qualified, and therefore in no sense of the word can the former be said to oust the latter.

After "A.I.E.E.'s" first statement his letter appears to be merely a violent tirade, without a shred of argument, against premium pupils in general and "truth" in particular, a tirade which is hardly justified by the somewhat flimsy excuse that his feelings have run away with him.

M. W.

It is amusing to compare the letter by "A.I.E.E." with the previous one by "Fact."

The latter says that the premium pupil at the end of his time "gets a comfortable job at a fair remuneration," while the former, on the other hand, says that "the question of salary troubles him not at all, and he is quite content to work for about as much money as wou'd keep an *ordinary* individual in tobacco."

"A.I.E.E." goes on to say that pupils generally take office as assistant engineers, here I agree with him, and to the fact that for his abilities he is very often underpaid I also agree.

This, however, is not ousting a draughtsman. In 99 cases out of 100 he would not accept the position of draughtsman, and hence he cannot oust him.

I am not talking of apprentices, but at the same time, if a draughtsman does get his *congé* in order to make room for an apprentice, your correspondent may feel very sure that the draughtsman is not wanted, and that replacing him by an apprentice affords a good excuse for getting rid of him.

I suggest to "A.I.E.E." that he should read "Fact's" letter, which he does not appear to have done.

Truth.

LONDON COUNTY COUNCIL.

As will be seen from the following, the most important events of interest to our readers, at the weekly meeting of the Council on Tuesday, were the telephone question, and the position of the London United Tramways Company in relation to the three "dead" sections in the county of London.

London United Tramways.

Mr. Horniman, on the motion for the reception of the report of the Highways Committee, asked the chairman whether the London United Tramways Company had undertaken to convert their lines in the county to the electric system.

Mr. J. W. Benn, in reply, stated that the company had forwarded a long letter on the subject, and that he would read extracts from it. Proceeding to do so (although he was rather indistinctly heard), the speaker observed that the directors intimated that, provided they could obtain the sanction of the Board of Trade, they were ready to carry out the Hammersmith section (conduit system) if the Council would enlarge the scope of its resolution so as to include the Goldhawk Road section in the overhead system, and would extend for seven years the purchase-period of the company's tramways. As a further matter, the company suggested that the Council should sanction the overhead system on the Goldhawk Road section in addition to that in Uxbridge Road, leaving the Hammersmith length of line out of the question altogether.

Commenting upon this reply, Mr. Benn remarked that, judging from its tenour, there did not seem much prospect of the company carrying out the work. At the same time the Highways Committee had yet to consider the whole of the contents of the letter.

The Telephone Service.

The Highways Committee announced having received a reply in reference to the recent request of the Council asking whether the Postmaster-General intended, in view of the expressions of opinion of the Select Committee on the Telephone Service, to take steps to establish an efficient telephone system for the county of London. The reply from the Secretary of the Post Office stated that the report of the Select Committee was being considered by the Government, and that if the suggestions made therein were adopted, Parliament would be asked to legislate on the subject.

In connection with this matter the Highways Committee drew attention to the recent statement made by the Postmaster-General to the Manchester deputation, on the October 31st. The Duke of Norfolk then stated that it must be taken as final that under no circumstances whatever would a license be granted to the New Mutual Company, or to any other new company; that he could give no definite information as to whether the Post Office would establish an efficient exchange within the Manchester area; that no license granted would extend beyond the year 1911; that he could give no promise that if the Manchester Corporation were to establish a telephone service of its own the Post Office would in 1911 purchase it at a fair valuation, but that probably if the Corporation were to promote a Bill with that object Parliament would see that the Corporation should suffer no injustice; that he could not say whether the Post Office would next session promote a general Bill to empower municipalities to create telephone exchanges under authority conferred by provisional orders; but that the Government after considering the report of the Select Committee on Telephones would no doubt bring forward proposals for such legislation as it deemed fit to give effect to those of the recommendations of the Committee as it might adopt.

The Highways Committee further reported that: "There is, in our opinion, urgent necessity for the establishment of a telephone service for the London district, in competition with the service provided by the National Telephone Company, and we think that every endeavour should be made to expedite the matter. It would appear from the letter from the Secretary of the Post Office, and from the reply of the Postmaster-General to the Manchester deputation, that there is some doubt whether the Post Office will at once, as it has power to do, establish this competing service. It is now too late for the Council itself to ask in the ensuing session for powers to establish a London telephone service, and should the Government fail then to introduce a general Bill to enable local authorities to establish services for their respective districts, either alone or in combination, the matter will be very seriously delayed, and, of course, the period within which the local authorities can expect to recoup some portion of the outlay will be shortened, and may render it impracticable for them to undertake the service." The Committee recommended that a letter should be forwarded to the Postmaster-General embodying the views above quoted, and pointing out the urgency and desirability of a decision being promptly arrived at by the Government as to whether the Post Office should establish a competing telephone service. This recommendation was unanimously adopted.

Dr. Cooper, before the adoption of the recommendation, asked the chairman of the Highways Committee whether it was a fact that the Corporation of Glasgow had received a license from the Postmaster-General, and, if so, why Glasgow should have powers which were refused to the London County Council.

Lieut.-Col. Ford said that it was a public scandal that those engaged in trade and commerce should be deprived of a reasonable telephone service.

Mr. J. W. Benn, in the course of a long reply, stated that he could not answer for the reasons which governed the Postmaster-General. Glasgow had succeeded, but so far as London was concerned they had not made any advance. The delay in the matter was a serious thing for London. It was five years since the Council had devoted attention to the matter. Since then they had persisted in the direction of obtaining improvements, but, as far as the company was concerned, London had been afflicted with a bad service, ruinous charges, and limited users; and they had insisted from the first that the killing of competition by the Post Office authorities had been the cause of all the troubles. The report of the Select Committee on Telephony had justified the action of the Council, but unfortunately the Postmaster-General did not accept the ruling of the Select Committee. He ventured to say that the Postmaster-General did not require any legislation to grant licenses, and he was extremely sorry that in consequence of the late arrival of the Post Office reply, the Council was unable at that period of the year to enlarge its Parliamentary notices in order to follow the example of Glasgow and and secure a telephone service for themselves.

Proceeding, the speaker said that London was being punished by no less than £50,000 a year in regard to the telephone service. The rental was only from 10 to 12 guineas in the provinces, as against £20 in London, where some £50,000 to £60,000 per annum was paid more than they ought to have to do. The company, in order to secure a monopoly had purchased the undertakings of 13 companies, and on going into figures, the speaker found that London had to pay the dividend on the watered capital consequent upon the purchase. The company declared that the Council had refused to consent to an underground service. Well, the position was this: The Council offered to give the facility if the company would place it on terms similar to those obtaining in Leeds, Manchester, Liverpool, and elsewhere, of a service at £10 10s. per annum, and of the payment of a rental for the use of the streets to the extent of 5s. for each subscriber, 10s. for each large junction box and 5s. for each small junction box. The Council had asked the company to do the same in London, and then they would proceed to business. If the terms in those cities were moderate, they only asked for moderate terms for London. In conclusion, Mr. Benn stated that all possible pressure would be brought to bear upon the Postmaster-General in order that London might have an efficient service at an early date.

Lighting of Cinematograph Lanterns.

In connection with the recent accident at the Tivoli, the Theatres Committee reported having considered the question of revising the regulations respecting the use of cinematograph lanterns in premises licensed by the Council for public entertainments. The Committee stated that the chemist, after conferring with the chief officer of the Fire Brigade, the architect, and some of the principal makers of the lanterns, had drawn up revised regulations which the Committee thought the Council should substitute for those now in force. Among these regulations, which the Council adopted, the following may be mentioned:—

The body of the lantern shall be constructed of wood or other non-conducting material, and shall be coated inside with asbestos, it shall also have an inner lining of sheet iron, and an air space shall be left between the iron and asbestos lining. In the bottom of the lantern shall stand an iron tray, which shall be surrounded by a vertical edge at least 1 inch in depth. The lantern shall be provided with a metal shutter, which shall fall freely between the source of light and the condenser. This shutter shall be immediately dropped in the event of any accident to the apparatus or stoppage of the film, and shall only be raised when the film is in motion for the purpose of projection.

Where possible the electric arc light shall be adopted as an illuminant, the usual rules for securing safety in an electric installation being observed. Ether and other inflammable liquids shall not be employed under any circumstances for producing light. If limelight be used in the lantern the general regulations for its safety, which are issued by the Council, shall be complied with, and any additional precautions which the Council may deem necessary for securing safety shall also be adopted. The use of acetylene gas is not permitted.

The space in which the cinematograph stands shall, where possible, be illuminated by electric glow lamps; but a miner's safety lamp may be substituted, if necessary. No naked gas or oil flames, or matches, shall be allowed in the space. The lighting of the hydrogen

flame in the lantern shall be accomplished by means of an electric lighter.

Loans for Works.

It was resolved, on the recommendation of the Finance Committee, to lend £10,490 to the Hampstead Vestry for additions to the plant at Lithos Road generating station, and £6,780 to the Islington Vestry for electric lighting purposes. As, in each case, the repayments will be spread over 42 years, the Council decided to inform the two authorities that it would not sanction the raising of any loan to replace the plant and machinery which may be necessary during the currency of the loan, and that renewals would have to be provided out of a sinking fund or from maintenance account.

LEGAL.

Boyce, French, and Bulwer v. The Alexandra Palace Electric Railway.

At the Wood Green County Court on 8th inst., his Honour Judge Edge, Q.C., had before him three actions for damages for personal injuries arising out of the accident on the electric railway in the Alexandra Palace grounds on Whit Monday last, when several passengers were injured.

The defendants did not appear.

Mr. Davies appeared for the first plaintiff, Mr. Boyce, a clerk, who claimed £20 5s. His case was that he and his wife were passengers in a car on the railway which was descending the slope from the Palace to Wood Green. The car ran away at a great speed, covered the whole length of the line in a very short space of time, and smashed into another car standing at the end. They were seriously injured.

His Honour gave judgment for the amount claimed, with costs.

Mr. Windsor appeared for the next plaintiff, a Mrs. French, who had been paralysed since the accident. She claimed £10 damages.

His Honour, in giving her judgment, with costs, thought the claim very moderate for such injuries as plaintiff received.

Mr. Windsor also represented John Bulwer, a signalman, who claimed £20 for the nine days he was incapacitated through the injuries he sustained.

The Judge thought £10 would be sufficient in this case, and gave plaintiff judgment for that amount, with costs.

Winfield v. Matthews.

Before Mr. Justice Lawrence and a special jury in London on Tuesday, plaintiff, a young man, secured a verdict for £300 against defendant, who was responsible for injuries suffered by him in January last. It was stated that defendant was erecting electric light standards in Chalk Farm Road, and one fell on plaintiff's foot and caused such injuries as required it to be amputated. He was laid up for over 15 weeks.

BUSINESS NOTICES, &c.

Alleged Perjury.—On 4th inst. John Limbrey Higgs, of Delahay Street, Westminster, appeared before Mr. Lushington, to an adjourned summons charging him with having committed perjury in his examination in respect to the liquidation of the I.E.S. Accumulator Company, of which he was a director. Mr. Horace Avory and Mr. G. A. Scott supported the summons; Mr. Charles Mathews and Mr. B. Denniss represented the defendant. It is alleged that in December, 1893, the defendant agreed to purchase the patent of an electrical accumulator for £2,000, and promoted a company to provide the purchase money. A sufficient sum not being subscribed, in May, 1894, he mortgaged the patent license to a Mr. Walton for £1,200, and subsequently sold the license to the I.E.S. Accumulator Company, of which he was a director, for £2,000. This company went into voluntary liquidation, and it is alleged that in his examination as a director, in order to justify his sale of the patent to the company, he falsely swore that the mortgage was paid off prior to August, 1895, when in fact it was not paid until October, 1897. Further formal evidence having been given, the summons was adjourned for a fortnight.

Announcement.—In our last issue we referred to the liquidation of the British Incandescent Electric Lamp Company. We understand that the company is merely winding up voluntarily for the purpose of reconstruction, this being necessitated by the want of additional capital. The works at Willesden Junction are being extended and larger plant put down to cope with increased business. The new company is known as the New British Incandescent Electric Lamp Company, and its registered office is Suffolk House, E.C.

Books Received.—"A Middle Algebra," by Wm. Briggs and G. H. Bryan. W. B. Clive, University Correspondence College Press, London. 3s. 6d.

"Electrical Engineering for Electric Light Artisans and Students," by W. Slingo and A. Brooker. Longmans, Green & Co., London. 12s.

Electrical Wares Exported.

Week Ending Nov. 8th, 1897.	£	s.
Adelaide	24	0
" Teleg. mat. ...	20	0
Amsterdam	120	0
Antwerp	81	0
Auckland	630	0
Bangkok	44	0
Bombay	238	0
Buenos Ayres	115	0
" " Teleg. mat.	13	0
Calcutta	328	0
Cape Town	248	0
Colombo...	20	0
Copenhagen	29	0
Demarara	15	0
Durban	271	0
Gothenburg	60	0
Hamburg	70	0
Hiogo	57	0
Launceston	19	0
Lyttleton	24	0
Madeira...	140	0
Madras	12	0
Marseilles	31	0
Melbourne. Teleg. cable	601	0
Montreal	93	0
Naples	450	0
Philadelphia	183	0
Port Elizabeth	826	0
" Teleg. mat.	180	0
Shanghai	155	0
Singapore	82	0
" Teleg. mat....	32	0
Stockholm	1,050	0
" Teleg. mat.	612	0
Sydney	1,105	0
Wellington	726	0
" Teleg. mat.	2,470	0
Total	£11,274	0

Week Ending Nov. 8th, 1898.	£	s.
Adelaide	1,148	0
Bombay	54	0
Boulogne	17	0
Brisbane	414	0
Calcutta	50	0
Cape Town	60	0
Colombo	225	0
Durban	775	0
East London	351	0
Gothenburg. Teleg. mat.	22	0
Hamburg	120	0
Launceston	90	0
Madras	76	0
Malta	86	0
Melbourne. Teleg. mat.	491	0
Montreal	123	0
Ostend	64	0
Rosario	239	0
Rio de Janeiro	65	0
St. Petersburg	30	0
Shanghai	156	0
Stockholm	470	0
Sirlina ... ... electric detonators	63	0
Sydney	655	0
Wellington	942	0
Yokohama	2,216	0
Total	£9,003	0

Foreign Goods Transhipped.

Sydney.	Telep. mat. ...	20	0
Trinidad	... ...	15	0
	Total	£35	0

Bankruptcy Proceedings.—Under the failure of Jacob Geetman, otherwise Jacob Goodman, gas and electrical fittings dealer, recently carrying on business at 48, Commercial Street, E., as J. Goodman & Co., the bankrupt attended at the London Bankruptcy Court last week for his public examination. He has filed accounts showing liabilities £3,850 15s. 8d. against assets consisting of £4,000, shares in J. Goodman & Co., Limited, which has been wound up in voluntary liquidation. The evidence of the bankrupt showed that he came over from Germany in 1889, and was in employment until 1893, when without capital he commenced business at 3, Broad Street Buildings, as the Victoria Lamp Maintenance Company. After trading there for 16 months he altered the business to J. Goodman and Co., electrical engineers, and shortly afterwards, having inherited about £500, to that of gas and electric fittings dealers. He subsequently removed to 20, New Broad Street, and from thence to 48, Commercial Street, E., where he traded until last April. The business, which was then insolvent, was in that month converted into a private company styled J. Goodman & Co., Limited, the debtor being appointed as managing director at a weekly salary of £5, and receiving 4,000 £1 shares in the company. The company undertook to discharge the outstanding liabilities but was unable to do so, to which fact, combined with loss on the trading and lack of capital the bankrupt ascribed his failure. The examination was concluded.

The first meeting of creditors in the failure of Claude Vantin, metallurgist, will be held at Bankruptcy Buildings, Carey Street, E.C., on November 11th, at 11 a.m. The public examination will take place on December 6th, at 11.30 a.m.

Dissolution of Partnership.—Messrs. R. O. Wright and T. J. Palmer (Russell O. Wright & Co., electricians, electro-metallurgists, &c., Blackburn and Darwen) have dissolved partnership by mutual consent. Debts will be attended to by T. J. Palmer.

Liquidation Notice.—At a meeting of Messrs. Easton, Anderson & Goolden, Limited, held at Broad Sanctuary Chambers on October 28th, it was resolved that as the company cannot, by reason of its liabilities, continue the business, that it be wound up voluntarily. Mr. W. B. Peat, 3, Lothbury, E.C., was appointed liquidator.

The Boilers at Hull Electricity Works.—The Lancashire boilers for this station, which we described in our last issue, have been supplied and erected by Messrs. Tinkers, Limited, of Hyde, near Manchester. Each boiler is 30 feet long by 8 feet diameter, and is designed for a safe working pressure of 150 lbs. per square inch. These boilers are stated to embody all recent improvements, and are furnished in the most complete manner with the reliable fittings and mountings, and are generally fully up to the standard of excellence for which Messrs. Tinkers are so justly

renowned. Since erecting the above boilers, Messrs. Tinkers have received a repeat order for an exactly similar plant, evidence that the Corporation are satisfied with the manner in which they have carried out their part of the contract, and also with this type of boiler for electric light purposes.

Change of Address.—Messrs. Le Carbone announce that on and after the 11th inst, their address will be 36, Lime Street, E.C.

Copper.—The effect of the gradual depletion of the stock of copper, brought about, says the *Financial News*, by the almost continuous excess of deliveries over supplies, is most signally shown by the fact that the price of g.m.b.'s and standard copper per ton has now reached a higher point than has been touched for many years. The statistics furnished by Messrs. H. R Merton & Co. show that the deliveries in October totalled 19,585 tons, while the supplies only reached 17,800 tons—a difference of 1,785 tons—and the stock in England and France and afloat thereto is thus brought down to 25,798 tons against 27,583 tons at the end of September, and against 34,389 tons on October 31st, 1897—a decrease on the year of no less than 8,591 tons. The price has accordingly risen to £54 15s., which marks an advance of £2 8s. 9d. on the month, and of no less than £7 on the quotation at the end of October, 1897. The supplies from North America are decidedly below the monthly average for the past year, and are 1,307 tons below the September total.

Cut-outs.— Messrs. Williamson & Joseph, Limited, of Northampton Grove, Canonbury, N., have acquired the sole license of the well-known Prentice patent automatic cut-outs.

Disclaimer.—Mr. A. E. Bennett, Examiner to Consolidated Telephone Company, Coventry, writes to point out that the reference to Mr. A. E. Bennett in Messrs. Williamson & Joseph's announcement in our last issue, does not refer to him.

Dividend.—A first and final dividend of 1s. 10½d. in the £ is payable on November 17th at 3, Grimshaw Street, Burnley, in the failure of J. Fletcher and J. A. Hirst (Fletcher, Hirst & Co.), electrical and mechanical engineers, Burnley.

Electric Power Transmission in Russia.—A central power station is being established at the Ischora shipbuilding and engineering works at Kolpino, Russia, not only for the electric lighting of the works, but also for the electrical operation of the cranes and the machine tools, &c.

Electricity for Mines Drainage.—The South Staffordshire Mines Drainage Commissioners have considered in committee the new scheme of electric pumping prepared by the general manager and engineer (Messrs. E. Howl and E. B. Martin), and it has been decided to negotiate with the British Electric Traction Company, Limited, which has undertaken the Black Country electric tramway scheme.

Fire.—The fusion of an electric wire is supposed to have originated an outbreak of fire in a draper's shop at 51, Strutton Ground, Westminster, late on Saturday night.

Fire Alarms.—The Brentford District Council has resolved to terminate its contract for electric fire alarm supply with Messrs. Stewart & Moore. The dispute between the parties is who shall bear the expense of false calls during the time the wires are under the control of the contractors.

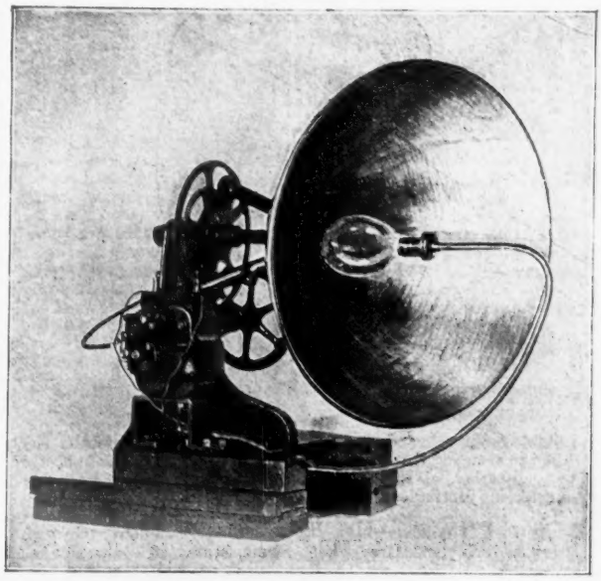
The Newport (Mon.) County Borough Council has been considering the subject of electric fire alarms for the streets, and such a system is to be introduced.

Catalogues, &c.—Mr. James Pitkin, of Red Lion Street, Clerkenwell, has issued descriptive pamphlets of his ammeters, voltmeters, and recorders, which have been supplied to a large number of electricity works in this country. Recording instruments are an absolute necessity in every central and sub-station, as correct records of the variations are most essential from every point of view. The Holden hot-wire recording voltmeter and ammeter, also the dead-beat magnetic recording ammeter for direct currents, are illustrated and described, prices being also mentioned.

Messrs. Flather & Son, of Park Electrical Works, Leeds (whose London and Southern Counties representatives are Messrs. E. H. Gudgeon & Co., of 85, Finsbury Pavement, E.C.) have issued a list of their continuous current dynamos and motors, giving specification, tabulated details and prices, also the Flather enclosed continuous current motor.

Messrs. Drake & Gorham send us a copy of their latest catalogue of electric lighting plant, brought up to date. By means of a thumb index reference to the various sections of the catalogue is made easy. The plant and accessories described comprise boilers, steam, gas, and petroleum engines, continuous current dynamos, D.P. storage batteries, the Neville automatic accumulator switch, for which the firm are sole agents in this country, belting, cables, and wires. There are numerous types of switches for various kinds of work, measuring instruments, incandescent lamps, and a large number of other articles for use in connection with electric lighting installations. Particulars are given of the Jandus lamp, the sale of which we understand is increasing very rapidly, and this has necessitated still further extensions in the offices and staff to cope with the orders. The catalogue will be useful for electricians and the trade generally, while there are also special features of interest to architects, clerks of works, and others, as there are stated the approximate initial outlay necessary in lighting country houses, and also particulars as to the working costs. Specimen estimates for 50 and 100 light private installations are found among various other useful matter.

Hart's Patent Automatic Flash and Search Light.—This apparatus is arranged and operated so that a powerful beam of white or coloured light can be caused to trace out any desired path, whether a simple circular one, or one of a complex nature, such, for example, as that represented by the curves seen on the back of a watch. The apparatus is entirely automatic in its action, and, being operated by electricity, can be worked from any direct or alternating electric circuit, and, consequently, when once started it



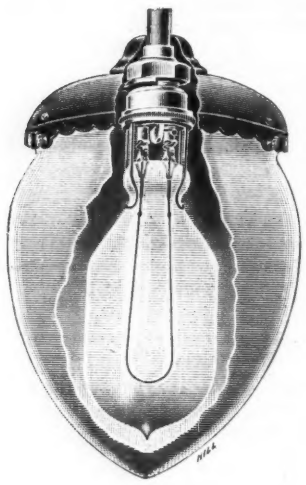
requires no further attention, and will continue to describe its path for any desired length of time. The stopping is effected by simply switching off the current. The apparatus will be found to be of the greatest utility as an automatic search light for use on land, on shipboard, or for coast or harbour defence. For this purpose a large size of apparatus and a powerful light are employed, and the gearing is so arranged that every part of the harbour, or waterway, is successively illuminated by the travelling beam. Again, the apparatus can be utilised to detect the approach of a hostile force, or of spies, while an army is encamped for the night; and it can also be applied to lightships and lighthouses, as well as to ocean-going craft of all descriptions. One of these new search lights, shown in the illustration, was exhibited on the great wheel at Earl's Court during the 1898 exhibition, and projected its beam of light through a complex path, such as that before mentioned, and was found to successively illuminate almost every part of the exhibition grounds; it was also plainly visible for a great distance outside of the grounds, and thus proved itself to be a great attraction. The apparatus is capable of being used for displaying goods in shop windows for decorative illuminations and a variety of other purposes; it should also be found useful for producing startling light effects on the stage, being fitted with clear or coloured electric lamps according to requirement. In the absence of an electric circuit the apparatus can be operated by a clockwork or other motor, the light in this case being obtained by oil or by oxy-hydrogen or other gas. Messrs. Niblett & Sutherland, of 61, Chandos Street, Strand, have the matter in hand, and have a working model on exhibition in their showrooms.

India-rubber.—Messrs. Jackson & Till's November 1st statement of stock of India-rubber in the United Kingdom shows that this year the total is 2,126 lbs. against 1,116 lbs. for 1897, and 1,875 lbs. for 1896. The prices for November this year are higher all round than in the same month of the two previous years.

A Liverpool Journalist's Error.—Messrs. R. W. Blackwell & Co. stand on their defence in the *Liverpool Post* of November 8th. A writer on the staff of that paper has been making a comparison of the Glasgow and Liverpool electric tram systems, and while praising the former very highly, he speaks in anything but congratulatory language of the latter. From his remarks it is clear that he is a stranger to his subject, otherwise he would not have said that the contractor for the overhead work at Liverpool had had no previous experience in this class of construction. The statement is, of course, calculated to harm the firm locally, therefore it is not surprising that they refute the charge of inexperience. Everyone who knows much about electric traction work in this country is well aware of the fact that Mr. R. W. Blackwell and his partner, Mr. Philip Dawson, have had a very wide connection with electric tramway enterprise both at home and abroad.

Main Box Explosions. — Two main box explosions occurred in the Strand, outside Messrs. W. H. Smith & Sons' establishment, on the 5th inst.

Lamp Fittings.—The Edison & Swan United Electric Light Company are now supplying a fitting, as shown in the illustration, which has been specially designed for use with high candle-power lamps (200 and 300 C.P.). It is claimed to be particularly



suitable for outside and shop window illumination, the globe carrier being so arranged that the internal part of the fitting is not affected by the weather, whilst the uppermost hood can be adjusted to allow of sufficient ventilation.

New Premises.—Mr. R. Plummer is about to open premises in Leyland Arcade, Lord Street, Southport, as an electrical engineer.

Messrs. Chovell, Simons & Co. have opened premises in Castle Yard, Richmond, as electrical engineers.

Paris Fire Alarms.—It is stated that the special lines of fire alarms in Paris comprise about 60 miles of telegraph and 140 miles of telephone wires, while there are 401 public telephone fire alarms and five electric. There are 310 alarms belonging to private individuals or business firms.

Release of Trustee.—The *London Gazette* contains notice of the release of trustee on September 27th (Mr. H. L. Price, of Manchester) in the matter of E. H. Berry (E. H. Berry & Pope), electrical engineer and contractor, Burnley.

The Society of Model Engineers.—Under the foregoing title, a new society has been formed, having for its objects the discussion of matters relating to the construction and working of model engines, dynamos, motors, steam and electric launches, tools, and small mechanical and electrical apparatus generally. The first meeting took place on November 2nd, at the Memorial Hall, Farringdon Street, E.C., Mr. Percival Marshall, A.I.M.E., presiding over a gathering of about 50 members and friends. A number of interesting models were exhibited on this occasion, including some small locomotives, a model gas engine, a small high-speed vertical engine, and a variety of model dynamos and motors, several of the latter being shown at work. The annual subscription to the society is 10s. 6d., and the secretary, Mr. H. Sanderson, "The Mount," Ealing, W., to whom applications for membership should be addressed.

Wigan Exhibition.—In connection with the Wigan Exhibition some of the public streets are lighted by electric arc lamps. For lighting the hall there are eight arcs and 100 incandescents. Among the exhibitors are the British Blahnik Arc Light Company, of London, who show various types of arc lamps, including the Borland scissors lamp, and their own newest type double-carbon 50-hour lamps. This exhibit also includes a 200-light dynamo, driven by an Eclipse gas engine, and an enclosed motor, as well as various switch and fuseboards, Mercier's mining bells, transformers, search lights, &c. The exhibition remains open until December 7th.

ELECTRIC LIGHTING NOTES.

Aylesbury.—The District Council has appointed Mr. F. H. Medhurst to report on electricity.

Belfast.—The electrical engineer has been authorised to advertise for tenders for additional plant required at the new station, and to arrange for the lighting of the Whitla Street fire station by contract, the committee not being in a position to compete, or desirous of competing, with the local firms in executing such work.

Bermondsey.—Notice of the application of the Vestry for a provisional order appeared in the *London Gazette* last Friday.

Bexley.—The new large Lunatic Asylum of the London County Council at Bexley, is being electric lighted by Edmundsons, Limited, under the superintendence of Mr. G. T. Hine, architect, and Mr. A. A. Campbell Swinton, consulting engineer. There will be some 3,200 electric lamps and electric generating plant of 300 kilowatts capacity. As the area covered is very considerable, the three-wire system of distribution is being employed, with 200-volt lamps.

Bloemfontein.—The Town Council of Bloemfontein has, according to the *Standard and Diggers' News*, decided to accept Messrs. Reunt & Lenz's (Johannesburg) tender for the installation of electric light for the town at a cost of £17,405, payments to extend over to the year 1901.

Bournemouth.—The Bournemouth and Poole Electric Light Company's request for consent to their proposed application for a provisional order has been referred to the General Purposes Committee. Meanwhile the Council has fixed upon an area for supply under the order it proposes to promote for a municipal plant.

Bow.—The Vestry has decided to defer the question of electric lighting at the baths in Roman Road until the Poplar Board of Works announce their charges for supply. The Board of Works engineer is at present preparing specifications, and current may be supplied in about 12 to 15 months.

Bromley.—The Electric Light and Power Company, Bromley (Kent) will shortly be in a position to provide electric energy for the purpose of supplying the new illuminant in the town and district. Mr. J. C. Gamlen is the resident engineer. The electric lighting station only requires a shaft (which is now being built) to complete it. A great deal of the plant is in position; cables have been laid almost throughout the entire district which it is proposed to supply, and within the next month or six weeks the Electric Light Company will be in full swing. Already several private installations have been supplied with power by the company.

Cardiff.—At a meeting of the Cardiff Governors under the Welsh Intermediate Education Act, it was resolved that the new buildings be lighted by electricity, and that the tender of Mr. S. F. Walker to make the installation for £465 be adopted.

Cheltenham.—At the municipal offices on November 4th, Lieut.-Col. A. C. Smith, R.E., Local Government Board Inspector, held an inquiry regarding the applications of the Town Council for sanction to borrow £17,000 for purposes of electric lighting. Among those present were Alderman Norman (chairman of the Electric Light Committee), and Mr. M. H. Kilgour (borough electrician). The town clerk stated that up to the present time the Corporation had borrowed £68,152 at various periods for electric lighting purposes, and had spent £64,107, leaving a balance of £4,045 applicable to extensions and machinery sanctioned in the last loan in February of this year. Owing to the demand for electric light it was necessary to make further extensions. Alderman Norman then gave some statistics relative to the progress of the electric lighting of the town. During the year 1895-6 they sold 47,700 units, the gross receipts being £1,050; the next year the figures were 90,300 units and £2,040; the following year 140,600 units and £3,215; and that of the current year he estimated at 204,200 units and £5,020. The first year there was a deficit on the working expenses of £622, but the next year there was a surplus of £54, which was increased the following year to £1,262; and this year the surplus would be about £3,000, sufficient to pay the whole of the interest and amount required by the sinking fund. In the first year there were only 19 customers, on October 24th last there were 269 customers with 17,400 8-candle-power lamps. For street illuminations 131 arc lamps were in use, and, compared with other towns, the financial success of the electric light in Cheltenham was very great. Mr. H. Kilgour then stated that if the steady increase of the past two years were maintained, and he had no doubt that it would be, the present works would be unable to cope with the demand.

Derby.—Mr. Wilmshurst, the new electrical engineer, entered upon his duties on October 31st. Several small extensions to mains have been agreed to conditionally.

Diss.—The District Council has agreed to the request of the Suffolk Electricity Supply Company for crossing the streets with their wires to supply current to consumers.

Dreghorn.—Messrs. Kenneth have had plant fitted up at their Mongomeriefield Colliery, Dreghorn, in order to provide an installation of the electric light for their brickworks, colliery, and other works and offices in the village. The current was turned on last week.

Dublin.—There was a brief failure in a portion of the street and private lighting on Saturday last.

Durham.—The City Council held a special meeting on Monday to consider the desirability of applying for a provisional order. A report by Mr. Hawtayne recommended the installation of a plant of 350 kw. capacity at first, the low tension direct current system to be adopted. The total cost for a plant of the capacity of 200 kilowatts, which would meet the requirements of the city, he estimated at £17,350; a plant of 350 kilowatts, which he considered it would be the wisest to instal, would cost £2,000 more, making a total of £19,350. At a charge of 5½d. per Board of Trade unit, he estimated a gross revenue of £2,956 12s., and this, with the working expenses

amounting to £1,767 10s., would leave a gross profit of £1,189 2s. The repayment of capital and interest at 5¼ per cent. on £17,500 would amount to £918 15s., which would leave them a net profit of £270 7s. on the smaller scheme. If the larger scheme were adopted, the working expenses would be £1,820, the gross profit £1,136 12s., and the net profit £112 17s.

The Sedgefield Asylum visitors, in their report to the Durham County Council on November 10th, reported that they had determined to instal electric light in the dining hall, the east and west wings of the main building, and in two of the principal wards. Arrangements had been made with the Corlett Electrical Engineering Company, Limited, for carrying out the work for £1,638. The contract was approved, and the seal of the Council affixed.

Farnham.—The District Council has deferred consideration of a report from Mr. F. Warden-Stevens on electric lighting until May next.

Hampstead.—The Vestry have requested their Finance Committee to consider the question of providing a reserve fund for the electric lighting scheme of the parish. The Lighting Committee has recommended that this shall be done out of the profits of the installation, which are about 10 per cent. on the capital borrowed, in order to provide for renewals and repairs of machinery, &c.

There was a partial failure of the Vestry's private lighting last Saturday night.

Hartlepool.—The Corporation's notice of application for a provisional order is filed in Tuesday's *London Gazette*.

Heckmondwike.—The District Council have decided to take the advice of an electrical engineer with a view to putting down a plant for public and private lighting. There are 28 applications for the post, but for the present the Council will not go beyond taking the advice of an expert. A Committee has been appointed to overhaul a detailed report on a scheme proposed half a dozen years ago, when the town decided against it.

Heston-Isleworth.—The District Council on Tuesday, on the recommendation of its Lighting Committee, resolved next year to apply for an order to light parts of their district by electricity. It was openly stated that this was intended to check all proposals by private companies.

Hull.—A Local Government Board inquiry, *re* applications to raise loans, was held on 1st inst. The sum included £26,000 for electric lighting purposes, and £4,103 for the purchase of site for dust destructor.

Islington.—The vestry clerk, Mr. W. F. Dewey, read a letter at the last meeting of the Vestry from the clerk to the London County Council referring to the London Overhead Wires Act. The Council inquired whether the Vestry had appointed any inspectors under the Act, and whether any steps had been taken in regard to the question of enforcing the bye-laws made under that measure. In the event of any action having been taken, the Council desired to be furnished with particulars of the cases for the information of the Highways Committee. It was decided to refer the matter to the Works Committee, with power to act. At the next meeting of the Vestry, Mr. Stonelake will move that the Electric Lighting Committee should be instructed to report the cost of providing the electric light from Highbury Corner along Canonbury Road and New North Road, in order that the Islington installation may meet the electric lighting system being at present carried out by the Vestry of Shoreditch as far as the boundary of that parish.

Lambeth.—The South London Electric Supply Corporation has not yet completed its own installation, but, pending such completion, a supply for lighting certain premises is obtained by contract with another electricity company. The consumers who are availing themselves of such supply in Brixton, Lambeth, and Tulse Hill were last week inconvenienced by a failure, the lights being out for about a couple of hours. A breakdown of a transformer is the alleged cause.

Larne.—Mr. M. Greeves Smyth, manager of the Larne Electric Light Works, Limited, writes as follows:—"My attention has been drawn to a note in the issue of the Electrical Review, dated October, 28th 1898, referring to a failure of the electricity supply in Larne on the 21st ult. The note is misleading; for the failure was but a partial one, and the streets were not left in total darkness. The cause was a hot bearing upon one of the alternators, which necessitated the shutting down of a pair of feeders for a very few minutes only."

Leyton.—The District Council has resolved to extend the mains *viâ* Leyspring Road to Bushwood Road at a cost of £650. The additional battery is now in operation at the electricity works, and the new engines are now nearly ready for running.

Lincoln.—The City Council has resolved to make application to the Local Government Board for power to borrow an additional £10,000 for electric light purposes. It is stated that about four miles of cable have been laid, and that the light will be available in a few weeks at most. To meet the demands of the citizens, the Council finds it already necessary to extend the mileage to about 10, and the power from 5,000 to 18,000 8-C.P. lamps. Hence the proposed increased expenditure.

Llandudno.—The electric light was switched on for the first time at Llandudno on Saturday by Mr. T. T. Marks, the chairman of the District Council. Amongst those who were present at the inauguration were Messrs. W. H. Preece, C.B., the chief electrician of the General Post Office, and A. H. Preece, consulting engineer for the work. The works have already cost £25,000, and it is estimated that a further expense of £5,000 will be involved.

London, E.C.—Mr. A. A. Voysey, the electrical engineer for the City, has just presented to the Court of Common Council his report on the work of his department during the past year. It appears that 78 meters were submitted by consumers to the engineer for testing during the period under review. Of these, 34½ per cent. were slow, and 22½ per cent. were fast, while 43 per cent. were approximately correct. The engineer reports that the total number of arc lights in the City is just 500. The number of lamp failures during the 12 months was 1,466. Reference is also made in the report to the steps which have been taken to test the volume of the electric supply to the City. With regard to the lamp failures, the number is more than double what was the case in the previous year. The proportion of group failures and single lamp failures has immensely increased during the last year, and it is said to be due to faults in the insulation of the cables. The company has taken steps to remedy these defects. The electrical engineer reports an improvement in the continuity of the electrical supply to private consumers. At the end of 1896 there was the equivalent of 247,785 lamps of 8-candle-power in the company's system of supply, while at the end of last year this number was 296,012—equal to an advance of about 19 per cent.

The Court of Common Council last week referred the application of the Metropolitan Electric Supply Company, Limited, for a provisional order for the supply of electricity within the City to the Streets Committee.

Longton.—The usual notice of application for a provisional order is filed in Tuesday's *London Gazette* by the Corporation.

Maidstone.—The Electric Lighting Committee of the Urban District Council reported at a meeting held on Wednesday, that they had had an interview with Mr. Manville, and had thoroughly discussed and considered with him the question of the erection of combined electricity supply works and dust destructor for the borough, and had come to the conclusion that it would not be advisable to advertise for designs and schemes as previously decided, and they now recommended that Messrs. Kincaid, Waller & Manville be instructed to draw up a report and scheme for carrying out the work, and also advising on the most suitable site. The committee's recommendation was adopted.

Manchester.—It is stated that on 3rd inst. some of the electric light cables in Pall Mall fused under the pavement. The Corporation officials subsequently laid about five yards of new cable.

The Corporation electric light installation is stated to have collapsed on Wednesday afternoon about 4 o'clock, and gas had to be used instead.

Matlock Bath.—The Urban District Council will do nothing in regard to provisional order this year as it is too late

Middleton.—The Council is advised by its expert to proceed with the powers granted under its provisional order. Great extensions have been going on at the gasworks, and it is proposed that here the electric supply works should be erected. It is estimated that the necessary plant and building would cost £19,300. It is further proposed to erect a refuse destructor at a cost of £3,500, and also to so construct the plant as to make it suitable for the supply of power to the new tramways company, if trams could be agreed upon. Altogether, it is proposed to borrow £33,500 for the works.

Motherwell.—A special meeting of the Town Council was recently held to decide the question of laying down an installation of electric light within the burgh. The Committee submitted a report by Prof. A. B. W. Kennedy. The total capital expenditure is calculated at over £23,000, the scheme providing, for private lighting, 30 arc lamps and 400 32-C.P. incandescent lamps for street purposes, and for power for mechanical purposes. The report was adopted.

Newport.—At a recent meeting of the Electricity Committee, the town clerk reported that the various contractors stated that the delay in completing their contracts was caused by pressure of work, which had accumulated in consequence of the engineers' strike. The office manager submitted his report for the quarter ended September 30th, 1898, as follows:—

	Total number of consumers to date.	Total number of lights connected (including arcs) equal to 8-C.P. lamps.	Units to be paid for during the quarter (including arcs).	Cost of generation and distribution per unit.	Total costs (not including sinking fund and interest).	Total revenue (including meter rents).
					£ s. d.	£ s. d.
	232	19,311	Inc. 29,003 Arc 19,810 44,873	4·45d.	906 13 5	948 12 2
Corresponding period last year	158	13,784	Inc. 18,420 Arc 19,753 38,173	4·08d.	650 14 5	733 19 8

His monthly report showed that the orders obtained for new connections were equivalent to 566 8-C.P. lamps, bringing the total number

of lights connected and on order up to the equivalent of 20,640 8-C P. lamps. The Dock Street main is to be extended, as Mr. C. D. Phillips has decided to take the light at his Emlyn works. Messrs. J. S. Stone & Son applied for terms for the supply of electrical motive power, and it has been decided that the charge for current for motors during the daytime only shall be 2d. per unit. The consulting electrical engineer attended, and submitted a report upon the progress of the various contracts for the extensions. He stated that the first set of plant would be delivered by Messrs. Fowler in the early part of next year. The temporary emergency plant would be ready for working shortly. The architect for the buildings attended the committee, and was urged to expedite matters in connection with the building extensions. A Pulsometer pump is to be obtained for dealing with the water likely to be met with in the excavations for the sunk bunkers. An order has been given to the Electrical Construction Company for two additional arc lamps, and two sets of transforming apparatus for stock, at a cost of £78 10s., based in the contract schedule The town clerk has been authorised to take out a new insurance policy for the whole of the plant and machinery at the central station. The gas company is to be notified to discontinue the lighting of the districts to be lighted by arc lamps from March 25th next.

Paisley.—The Town Council is opening negotiations with Sir Michael Shaw-Stewart for the acquisition of from two to three acres of ground to the east of the electric works for the purpose of making extensions.

St. Pancras.—The Vestry has increased the salary of its chief electrical engineer, Mr. S. Baynes, from £600 to £700, and it will be further increased to £800 by two annual instalments of £50.

Plumstead.—The *London Gazette* for November 8th contains copy of the Vestry's application for a provisional order.

Rathmines.—Mr. Hammond's report on the electric lighting of the township is being printed, and a copy will be placed in the hands of each of the Commissioners.

Rhyl.—The Council will hold a special meeting on 28th inst. to pass formal resolutions in regard to its application for a provisional order.

Ross-shire.—Cromartie House was the scene of elaborate festivities early this month. The Countess of Cromartie and Mr. Richard Cavendish entertained a large shooting party, and for the occasion an electric lighting installation was put down for the purpose of lighting and decorations. The plant was provided by Mr. P. C. Middleton, of Aberdeen. A steam engine and dynamo (12 H.P.) were put down 150 yards from the house. The various corridors and rooms were beautifully illuminated and decorated, the electrical effects being very charming.

Rotherham.—The District Council has resolved to apply for a provisional order.

Runcorn.—In the *London Gazette* for November 4th, notice is given of the application to be made by the Runcorn District Council for a provisional order.

Ryde.—Last week the Town Council resolved that the necessary steps be taken to procure a provisional order for electric lighting.

Sale.—The District Council has made an application to the Manchester Corporation respecting the terms for a supply of electric current to Sale.

Shanklin.—The Town Council have entered into an agreement with Edmundsons' Electricity Corporation, whereby the latter obtains the electric concession for the town.

Shoreditch.—The Vestry has decided to lay down about 180 yards of concentric cable from the Clifton sub-station to High Street, Shoreditch, in order to balance the pressure between the two places at a cost of about £125.

Sleaford.—A committee of the Tradesmen's Association have sent a petition to the Urban District Council asking that they should appoint a committee to confer with respect to a proposal to introduce the electric light into the town. Their wish was acceded to, but from the tone of the councillors there does not seem much prospect that it will be installed. The Gas Company have just intimated that in the first quarter, next year, they will reduce the price of gas from 3s. 9d. to 3s. 4d. per 1,000.

Slough.—The proposal to light Slough by electricity has not found much favour with the members of the Urban District Council. Several meetings have been held to discuss the question, and ultimately it has been decided to refer the matter back for the Lighting Committee to make further inquiries.

Southampton.—The Electric Lighting Committee has appointed Mr. F. H. Chaplin, of Portsmouth, electrical engineer, at a salary of £250 per annum. There were 66 applications.

Stretford.—A Manchester paper says that a public meeting will shortly consider an electric light scheme for the district.

Tanfield.—The Urban District Council has decided to adopt the Lighting Committee's recommendation to illuminate the district by electricity, and a contract has been duly sealed.

Teignmouth.—The District Council has discussed the question of obtaining a provisional order, and it was agreed to send a draft and report to the Board of Trade.

Trinidad.—Mr. J. Stanley Richmond, who was appointed by the Government to make a thorough investigation of the electrical resources of Trinidad, West Indies, has just returned to this country. Mr. Richmond, who has been away seven months, had to investigate and report on the electric lighting, power, and telephone system of the island. It was believed that these resources had not been efficient and safe, and Mr. Richmond was appointed to ascertain what was required to place them on a satisfactory footing. He has accomplished his mission, and has brought home with him a very complimentary letter from the Governor of the island, Sir Herbert Jerningham.

Walker.—The usual notice of application for a provisional order is filed in the *London Gazette* of 4th inst. by the Urban District Council.

Warrington.—Messrs. Fletcher, Russell & Co.'s new foundry, now constructing, is to be lighted electrically, and Messrs. T. Lawrie & Co., of Falkirk, are carrying out the work. The blowers and fitting-shop machinery will be driven by electric motors. A large generator will be connected to the main engine.

Wath.—The District Council has resolved to make application to the Board of Trade for a provisional order.

Welbeck.—For some time electricians have been busy at Welbeck making the necessary arrangements for the introduction of the electric light. The whole of the rooms in the Abbey, both above and below ground, have been supplied with the new light, as has also the long tunnel, 2½ miles in extent. The tunnel was lighted up with electricity for the first time last week. The arrangements have been carried out under Mr. Watley, the chief engineer.

West Hartlepool.—The plans for the electric lighting station not having given satisfaction, it has been decided to invite Prof. Kennedy to visit the borough, and provide plans for a generating station similar to that at Sunderland and at a similar cost. The Electric Tramway Company has consented to the Corporation utilising the tramway poles for supporting arc lamps.

Weybridge.—The Urban Council has appointed a small Committee to consider the draft provisional order of the Electric Light Works Company in respect to the urban districts of Walton and Weybridge.

Whitechapel.—The Electric Lighting Committee recommends the District Board to purchase the premises of Messrs. Ind, Coope & Co., in Osborne Street, at a cost of £18,250, as a site for electricity works.

Winchester.—At a meeting of the Board of Guardians on Saturday last, the Visiting Committee reported that they had had for some time under consideration the desirability of introducing the electric light into the workhouse. They had made full inquiries, and were of opinion that the change would be advantageous not only on the score of expense, but also on the score of health and cleanliness. They had obtained estimates of the probable expenditure, and recommended that the lowest tender be accepted. Mr. Councillor Goodbody presented a special report, showing that the average cost of lighting the house during the past five years had been £115 15s. 11d, including £2 a year for rent of gas meters. A very heavy expenditure had also been incurred for painting and whitewashing, much of which would be obviated by the use of the new illuminant. The tenders for the installation of the electric light were: Messrs. Dicks & Sons (Winchester), £166; Messrs. Fiford (Southampton and Winchester), £198 8s. 6d.; Messrs. Gudgeon (Winchester), £279 10s. 6d. Messrs. Dicks's tender was accepted.

Winton.—The District Council has given its consent to an application from the Bournemouth and Poole Electricity Supply Company, Limited, for permission to lay their wires underground through the main road.

Wombourn.—The Parish Council has referred a proposal to light the village by electricity to a committee.

Worcester.—The Electricity Committee will recommend Mr. F. H. Lewis, of Wolverhampton, for appointment as electrical engineer by the City Council (on November 16th) at a salary of £350 a year. There were 29 applications for the appointment, and five selected candidates were interviewed by the Committee. Mr. Lewis has held appointments successively under the Hull and Wolverhampton Corporations.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Belfast.—The Electric Committee still "think it advisable to go for a Bill for the establishment of electric traction for tramcars, and in particular on the new routes with their connecting links."

Brentford and Hanwell.—The London United Tramways Company have abandoned the construction of the line from Brentford to Hanwell, for which they obtained a Bill in last Parliament. The reason for this action is the position taken up by the Brentford District Council. When the terms were arranged between the Council and the company prior to the passing of the Act, the company agreed to widen the Halfacre, an old thoroughfare along which

the line would run, to a uniform width of 40 feet. They duly sent in their plans, showing how they would accomplish the widening, but to these the Council demurred. They showed the taking of 12 feet on one side of the thoroughfare, but the Council required that 15 feet should be taken, and the widening effected on the opposite side to that proposed by the company, as some old and tumble-down property would thus be got rid of. It involved, however, the acquisition and removal of an extensive public house, and the tramway company declared that they would not spend so much money. They urged that they were not bound down to acquire property on either particular side of the street, and that which they proposed taking would involve them in the least expense, and would, at the same time, give the town a good wide road. The plans originally deposited were withdrawn, and the company intimated they would furnish others if the Council would come to more reasonable terms than they had hitherto laid down. The Council declined to alter their decision, and the company thereupon abandoned the line.

Brentford and Hounslow.—The commencement of the construction of the new line with overhead traction from Kew Bridge to Hounslow has been delayed, owing to the action of the Middlesex County Council requiring that creosoted fir blocks shall be laid between the rails. The tramway company propose to lay Jarrah wood blocks, and upon the question as to which shall be used, they have gone to the Board of Trade. The decision of the Board is pending, but until it is received a start cannot be made. The Brentford District Council have approved the plans of the line as it is to be laid, and have acknowledged the receipt of £5,000, the moiety of the expense of widening the High Street, one of the conditions inserted in the Bill. The Heston-Isleworth District Council have agreed to consent to the plans and drawings of the lines, posts, cars and points, on condition that the lines are paved with Jarrah blocks or other hard wood, and the outsides of the rails being paved with granite setts. They have petitioned the Board of Trade to refuse to sanction any future application by the tramway company, and the Middlesex County Council to refer to arbitration any question as to the paving material to be used on the roads along which the tramway will pass. On Monday the Board of Trade arbitrator, Col. Hutchinson, sat to hear the dispute between the Middlesex County Council and the London United Tramways Company as to whether the lines to be laid through Brentford and Hounslow shall be paved with Jarrah wood, or creosoted fir blocks, or granite setts. The company desire to use Jarrah blocks, but the County Council, so far as Brentford is concerned, require the fir blocks, and as to Hounslow, granite setts. The District Councils for both localities appeared to urge that the road was vested in them, and they had the right to determine the material used, but the arbitrator held that they had no *locus standi*. He reserved his report and award for further consideration. The Hounslow District Council at their meeting on Tuesday fully discussed the question, and resolved to take action to resist granite being used, as it would make too great a noise.

Darwen.—The Town Council will, on December 5th, hold a special meeting to consider whether to purchase that portion of the Blackburn and Over Darwen Tramways Company's undertaking within the borough of Darwen. The Blackburn and Darwen Corporations will, between them, pay £48,500 for the undertaking, Messrs. Bramwell & Harris being suggested to apportion the sums to be paid by each town, unless an agreement is entered into.

Dublin.—On 2nd inst. Sir F. Marindin held a Board of Trade inquiry at the Tram Company's offices into the application of the Dublin United Tramway Company and the Southern Districts Tramways Company for authority to increase the speed of the electric trams on their Dublin and Clontarf and Dublin and Dalkey systems. Considerable evidence was given for and against the proposal.

Dudley and Sedgley.—In the ELECTRICAL REVIEW of last week we mentioned the fact that the British Electric Traction Company had purchased the lines of the Dudley, Sedgley, and Wolverhampton Tramways Company. It is now stated that the Traction Company will unite the Dudley and Stourbridge line, belonging to the same company, with the line to Sedgley and Wolverhampton, by extending the latter in two directions, one route being along Priory Street and Stone Street, and the other down the Wellington Road; all in Dudley. This arrangement will considerably reduce the number of turn-outs, and make the service of the two systems more complete and effective. So far as the Dudley, Sedgley, and Wolverhampton line is concerned, the scheme at present proposed is identical to that introduced by the British Electric Traction Company two years ago, which was opposed by the Wolverhampton Corporation, whilst the method of construction and equipment will be the same as that adopted in connection with the line from Dudley and Stourbridge. The overhead span-wire system will be introduced. The new cars will be of the "one storey" type, with a total length of 27 feet 3 inches, fitted with enclosed cabs at each end. There will be a regular ten-minutes or quarter-of-an-hour service, instead of the present hourly service. The scheme will be shortly laid before the various local authorities concerned. No obstacle, it is anticipated, will be put in the way of the proposals by the Dudley Corporation or the Sedgley and Coseley District Councils, although some difficulty may be experienced in reference to the Wolverhampton portion extending from the Fighting Cocks to Snow Hill. The question of the supply of electrical energy required for the new line from Dudley to Sedgley will probably give rise to considerable discussion. The Dudley Corporation have obtained an electric lighting order, and have throughout their negotiations with the British Electric Traction Company, insisted, not only upon their becoming the owners of all the electric tramways in the borough, but also retaining the right to supply the electrical energy. This favourable position gives the Corporation of Dudley the privilege of adopting one of two policies—either they can work the order themselves, or lease it for ten years. In the event of the latter course being adopted, the company supplying the electrical energy for that portion of the Stourbridge line within the borough of Dudley will in all probability cater for the Sedgley line. At the same time it would be quite competent for the British Electric Traction Company to do as they have done at Round Oak for another branch of their system, erect a generating station within the Sedgley district and provide their own electric power.

Dundee.—It is stated that an electric tramway scheme is being considered by Councillor Longair, under which advantage will be taken of the existing rails for a certain distance. The proposed route has some very steep gradients (1 in 8·76). The matter will come before the Tramways Committee, and if approved will be incorporated in the Parliamentary Bill.

Electric Traction on French Railways.—A party of five engineers of the Orleans Railway Company some months ago paid a visit to the United States to inquire into the question of electric traction on railways in view of the adoption of the same on the new extension in Paris between the Place Walhubert and the Quai d'Orsay. The report of these engineers is favourable to the adoption of electric traction.

Manchester.—The tramways deputation which has been to the Continent, &c., recommends the overhead trolley system. The Tramways Committee in its report summarises the works, buildings, cars, and appliances which will be required, and points out the urgency of beginning operations speedily if the municipal tramways are to be ready by April 20th, 1901, the date of the expiration of the present lease to the Carriage Company. Borrowing powers will have to be obtained to cover the whole cost of the transformation, but the Committee do not venture to estimate the amount. This will largely depend on the number of miles which will have to be relaid, and the cost of land for car sheds, workshops, and generating stations. No suggestion is made to take over any of the properties of the Carriage Company.

Middlesbrough.—The Streets Committee has agreed to approve the application of the Imperial Tramways Company for sanction to apply for powers to extend the tramways either down Dock Street or Commercial Street and beyond the borough boundaries, under the Light Railways Act.

Newcastle.—The City Council last week approved various clauses for inclusion in the proposed Tramways Bill. Power to use electricity is sought, and also provisions made as to junctions with tramways beyond the city, that the Corporation may use their vacant ground, containing 4,657 square yards, at the Manors, for the purpose of generating electric energy, and that, if any of the tramways are worked by electricity, the Corporation shall have power to light by electricity the streets and any building, quay, market, or other place within the city lighted at the expense of the Corporation, and to use electric energy as a motive power for all purposes of the Corporation for which such motive power is or may be applicable.

Portsmouth.—The Tramway Committee have presented a report to the Town Council, recommending that the necessary notices be given under the provisions of the Portsmouth Corporation Tramways Act, 1898, for acquiring the whole of the tramway lines within the borough, and the piece of line from the borough boundary to Cosham. The committee state that they have had considerable difficulty in presenting an estimate of the cost of acquiring the existing tramlines, owing to the fact that the price is to be determined by an arbitrator appointed by the Board of Trade, and it would be undesirable to venture to mention a specific amount. Under these circumstances the committee have made inquiry of other towns, and have based the following figures entirely from information so obtained. Estimate—Cost of obtaining and reinstating with electric equipment, including cost of Bill, legal and other expenses, £210,250; 66 cars, £35,000—£245,250. Estimate of the annual expenditure—The annual interest and sinking fund will be £12,099; management, including sufficient drivers and conductors to allow a much shorter working day than is now the case, and also including the whole staff required for maintaining the roads, and running and maintaining cars, £17,500; rates, taxes, &c., say, £2,000; stationery and stamps, £500; material for repair of cars, &c., £2,400; material for permanent way, £1,500; charge for current at 1½d. per unit, £6,627—£42,626. The committee have based their annual expenditure upon the mileage of 1,281,000 miles per annum, which works out rather less than 8d. per car mile. It is stated that the present company run their cars 928,283 miles per annum, and that they earn an annual revenue of £36,571, equivalent to rather more than 10d. per car mile. Upon these figures, and assuming that a similar amount can be earned, viz., 10d. per car mile, the gross revenue would be £53,375; but even if only 9d. per car mile should be earned, the gross revenue would be £48,037, being largely in excess of the annual expenditure as estimated above.

Twickenham and Hounslow.—The Drake and Gorham electric traction light railway proposals have in the past week been extended by the addition of a suggested route from the centre of Twickenham to Twickenham Common on the road to Teddington. The London United Tramways Company have not yet deposited the plans of their proposed applications respecting the Twickenham district, but they have intimated that they will seek powers to run for their new Brentford line along Twickenham Road through Isleworth, over Twickenham railway bridge, and thence take some of the roads leading to Kingston. From Twickenham Bridge their line will clash with the Drake and Gorham system for about 300 yards, but otherwise they run over entirely new ground. Their service, if carried out as proposed, would pass by a number of new building estates, and

within very easy distance of others, besides affording the town of Isleworth what it desires, better travelling facilities. A petition in Hounslow in favour of the Drake and Gorham Company's proposals has received many signatures.

Yarmouth.—At a meeting of the Town Council on Tuesday, the question of electric tramways for the borough again came up. Extending the scheme already adopted, the Council decided to ask for Parliamentary powers to borrow £53,000 instead of £42,000, the larger sum being necessitated by public improvements in connection with the tramways. At the same meeting the surveyor advised that the proposed communication between Yarmouth and Gorleston—the two parts of the borough which are separated by the harbour—should be, by means of masts and overhead cables, 162 feet above high water mark. Messrs. Bullivant, of London, makers of wire-rope railways, had given him prices for the erection of the necessary work. The Council resolved unanimously that, provided the requisite assents be obtained, the electrical communication between Yarmouth and Gorleston be by means of the overhead system, and directed the surveyor to confer with Mr. W. H. Preece on the subject.

TELEGRAPH AND TELEPHONE NOTES.

The City and the Telephone Service.—At the meeting of the City Corporation last week, Mr. Moojen moved that it be referred to the Streets Committee to consider the desirability of the Corporation applying for a license to establish a telephone service either solely or in conjunction with the County Council. The County Council had decided to apply for a license, and he hoped some action would be taken by it as representing the classes who mostly needed the telephone.—Mr. Foster M'Geagh, in seconding, said the telephone service at present was of very little use to City men, and it was his opinion that it would never be any better so long as the service was in the hands of the National Telephone Company.—Mr. Morton suggested that the words "and all other local authorities within the London telephone area" be added.—This was agreed to, and the motion as amended was carried unanimously.—The Streets Committee later on recommended that the necessary steps be taken to urge upon the Government the extreme desirability of action being taken forthwith to give due effect to the recommendations of the Select Committee on the Telephone Service.

Swansea Telephones.—The National Telephone Company have just completed the substitution of a triple line of pipes underneath the main streets of Swansea for the overhead wires.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies—		
St. Lucia-St. Vincent ...	Sept. 24th, 1898 ...	...
Amazon Company's cable—		
Cable beyond Gurupa ...	June 8th, 1898 ...	...
Bolama-Bissao	June 21st, 1898 ...	...
Gibraltar-Tangier	Oct. 8th, 1898 ...	Nov. 4th, 1898.
Pernambuco-Ceara	Oct. 19th, 1898. ...	...
Saint Louis-Novonha ...	Oct. 17th, 1898 ...	...
Landlines.		
Saigon-Bangkok	Oct. 31st, 1898 ...	Nov. 2nd, 1898.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barrow-in-Furness.—November 14th. The Corporation invite tenders for the supply and erection of cast-iron lamp columns, arc and incandescent lamps, automatic switches and fittings. Messrs. Kincaid, Waller & Manville, consulting engineers. See our "Official Notices" October 28th.

Belfast.—November 14th. The Harbour Commissioners want tenders for the supply of nine iron lattice-built electric light masts, 70 feet high from the ground with suitable base. Mr. W. A. Currie, secretary, Harbour Office, Belfast.

Belfast.—November 17th. The Corporation is inviting tenders for the supply and erection of four 400-kw. steam dynamos for the Electric Committee. Specification, &c., from the City Electrical Engineer, Mr. V. A. H. McCowen.

Blackpool.—Corporation wants tenders for trolleys, wire, &c., in connection with conversion of conduit lines. See our "Official Notices" this week.

Dublin.—December 5th. The Dublin United Tramways Company is prepared to receive tenders for the supply of general stores, including car fittings, iron, steel castings, oils, electrical supplies, &c., &c., for the year ending December 31st, 1899. Information can be obtained, and patterns seen, at the company's offices, 9, Upper Sackville Street, Dublin, from November 15th to December 2nd. Forms of tender 1s. each.

Dublin.—November 14th. The Board of Public Works is inviting tenders for the hire of plant, &c., required for the electric lighting of the State Apartments, Dublin Castle, during the next castle season. Specifications to be seen at the office of the Secretary, Mr. H. Williams.

Edinburgh.—November 14th. The Council want tenders for the supply of marine boilers and mechanical stokers and engines and dynamos for the electric light station in McDonald Road. Consulting engineer, Prof. A. B. W. Kennedy, 17, Victoria Street, S.W., at whose office specifications and drawings may be seen. See our "Official Notices" October 28th.

Glasgow.—November 22nd. The Corporation is inviting tenders for the supply and erection of switchboards and instruments for the new electricity works at Port Dundas. Specifications, &c., from Mr. W. A. Chamen, electrical engineer, 75, Waterloo Street, Glasgow. See our "Official Notices" November 4th.

Hanley.—November 14th. The Corporation is inviting tenders for the erection of a refuse destructor. Particulars from Mr. J. Lobley, borough engineer.

Hill of Howth.—November 19th. The Great Northern Railway Company (Ireland) is inviting tenders for the following in connection with their power station to be erected at Sutton, near Dublin, viz:—Lancashire boilers, with or without mechanical stokers, engines, dynamos, pumps, piping, crane, feed heater, and tools; switchboard. Specifications to be seen at the office of Prof. A. B. W. Kennedy, 17, Victoria Street, S.W. See our "Official Notices" November 4th for further details.

India.—November 23rd. The East Indian Railway Company is desirous of introducing electrically-controlled block instruments on their system, and invites proposals from makers only for the supply of: For single line—18 instruments for nine blocks; for double line—80 instruments for 41 stations, and six spare instruments. Particulars from Mr. A. P. Dunstan, secretary, Nicholas Lane, London, E.C.

Leeds.—November 9th. The Leeds Corporation wants tenders for an electrical installation at the Judges' House, Clarendon Road. Plans and specifications seen, and forms of tender obtained, at the city engineer's office, Municipal Buildings.

Middlesbrough.—November 29th. The Electric Lighting Committee is inviting tenders for the supply and erection of Lancashire boilers, and boiler house plant, slow speed steam dynamos and accessories, condensing plant and pipe work, overhead travelling crane, switchboard and instruments, accumulators, supply and laying of cables, meters. Specifications, &c., from the consulting engineer, Mr. Robert Hammond, 64, Victoria Street. See our "Official Notices" October 28th for further particulars.

Redditch.—The Urban District Council is wanting proposals from firms of contractors who would undertake the wiring of consumers' premises on a hire purchase or deferred payment system. See our "Official Notices" October 28th for further particulars.

Salford.—December 1st. The Electric Lighting Committee want tenders for the supply and erection of the following plant for the Electric Light Committee. Section (1) boilers; (2) engines; (3) dynamos; (4) boiler feed pumps, &c.; (5) mechanical stokers; (6) superheaters; (7) economisers; (8) condensers, &c.; (9) steam and water pipes; (10) cranes and weighing machines; (11) tanks, &c.; (12) switchboards; (13) booster. Specification, information, &c., may be obtained from the electrical engineer, Walness Road, Broughton, on payment of £5, returnable as usual.

Shanghai.—The Shanghai Municipal Council invites tenders for a concession for constructing and working about 23 miles of electric tramways on the trolley system in the streets of Shanghai. Plans may be seen and particulars obtained on application to Messrs. John Pook & Co., 8, Jeffreys Square, St. Mary Axe, London, E.C.

Southampton.—November 16th. The Committee of Visitors of the County Lunatic Asylum, Knowle, near Fareham, is inviting tenders for the supply of two engines and dynamos equal to an output of 24,000 watts each, together with all necessary washing machinery, lathe, drill, motors, lamp installations, &c., required in connection with the centralisation and increase of the light, heat, and power generating plant. See our "Official Notices" October 7th re specifications, plans, &c.

(*Continued on page 715.*)

TESLA'S SYSTEM OF ELECTRIC POWER TRANSMISSION THROUGH NATURAL MEDIA.

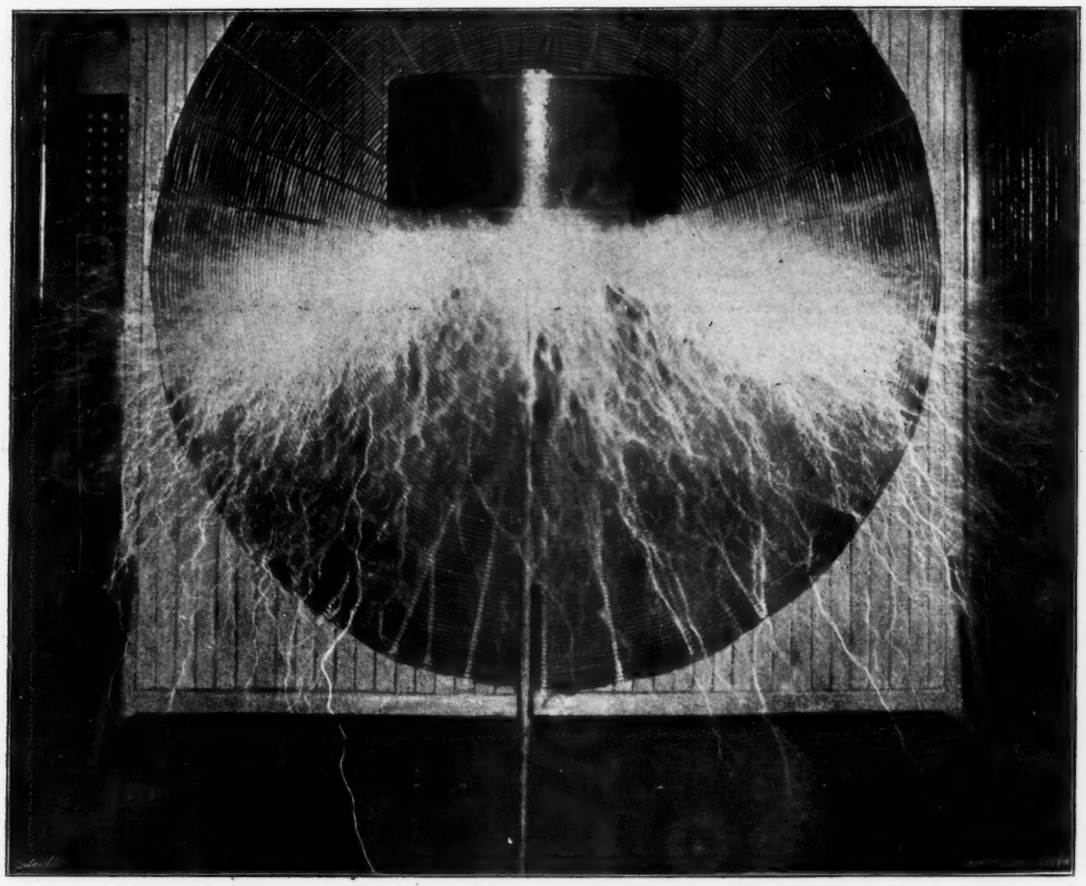
The *Electrical Review*, N.Y., of October 26th, gives a description of a new method of electric power transmission invented and patented by Tesla, the well-known electrician. The description appears to be taken from Tesla's patent specification, and is of a somewhat general nature; but is sufficient to enable us to understand the principle of the startling novelty which Tesla proposes to introduce into our methods of transmitting power by electricity. The following is a summary of our contemporary's article:—

It has long been known, that if air enclosed in an insulating vessel is rarefied, its resistance is reduced to such an extent, that it may be considered a true conductor of electricity, though one of admittedly high resistance. The practical information on this subject, has, however, been derived from observations, manifestly subject to limitations imposed by the character of the apparatus or means heretofore known, and the kind of electrical effects which could be produced.

Tesla's invention consists in transmitting electrical power without the employment of metallic line conductors, by taking advantage of the conductivity of the layer of rarefied air which exists in the higher regions of the atmosphere. But in order to make this practicable, he has devised special apparatus for the production and conversion of excessively high electrical pressures.

Heretofore, it has been possible, by means of the apparatus at command, to produce only moderate electrical pressures, and even these, with considerable risks and difficulties. Tesla, however, claims that he has devised means, whereby he is enabled to generate with safety and ease, electrical pressures measured by hundreds of thousands, and even by millions of volts. He has also, during his investigations with such apparatus, discovered certain highly important and useful facts, which are said to render practicable his new system of transmitting electrical energy.

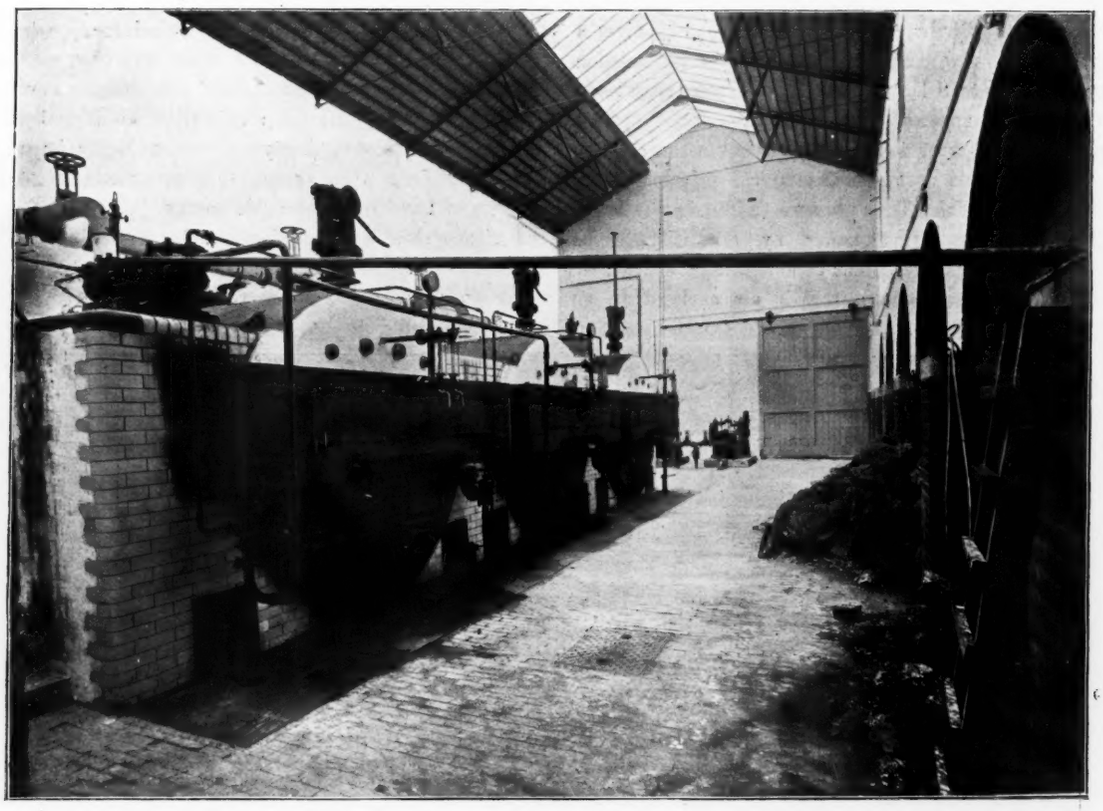
Among these are the following: first, that with electrical pressures of the magnitude and character which he has been able to produce, the ordinary atmosphere becomes, in a measure, capable of serving as a true conductor for the transmission of the current; second, that the conductivity of the air increases so materially with the increase of electrical pressure and the degree of exhaustion, that it becomes possible to transmit through even moderately rarefied strata of the atmosphere, electrical energy up to practically any amount and to any distance.



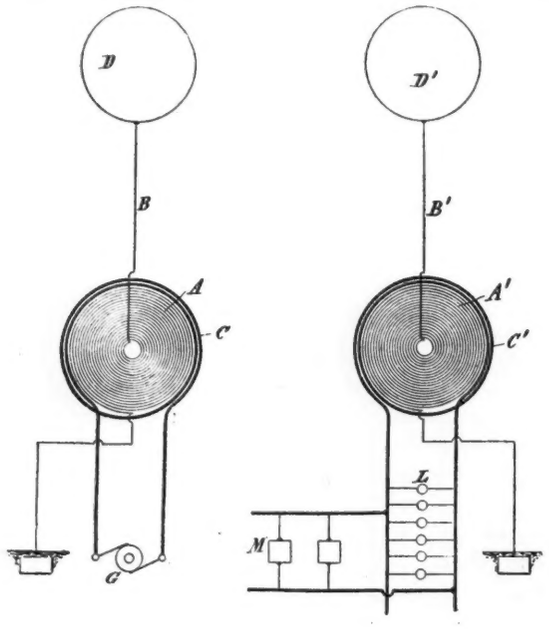
View of model transformer, or "oscillator," photographed in action.—Actual width of space traversed by the luminous streams issuing from a circular single terminal, over 16 feet.—Area covered by the streamers, approximately 200 square feet.—Estimated effective electrical pressure, 2½ million volts.

In order to carry out his system of power transmission, Tesla has designed special apparatus capable of generating electrical pressures vastly in excess of any hitherto made use of. One terminal of this generating apparatus is connected to earth, and the other terminal is maintained at an elevation, where the rarefied atmosphere is capable of conducting

freely the particular kind of current produced. Then at the distant point where the energy is to be utilised, a terminal is maintained at an equally high elevation, to receive the current and to convey it to earth through suitable means for transforming and utilising it.



Folkestone.—View of Boilers.



The apparatus by means of which this method of transmission may be effected, is represented diagrammatically in the accompanying figure.

A is a coil, generally of many turns, and of very large diameter, wound in spiral form, either about a magnetic core or not, as desired. C is a second coil formed by a conductor of much larger size and smaller length, wound around in proximity to the coil A.

In the transmitting apparatus the coil A constitutes the high tension secondary, and the coil C the primary, of much lower tension, of a transformer. In the circuit of the primary, C, is included a suitable source of current G.

One terminal of the secondary, A, is at the centre of the spiral coil, and from this terminal the current is led by a conductor, B, to a terminal D, preferably of large surface, formed of, or maintained by such means as a balloon at an elevation suitable for the purposes of transmission as before described. The other terminal of the secondary, A, is connected to earth and, preferably, to the primary also, in order that the latter may be of approximately the same potential as the adjacent portions of the secondary, thus insuring safety.

At the receiving station a transformer of similar construction is employed, but in this case the long coil, A', constitutes the primary, and the short coil, C', the secondary of the transformer. In the circuit of the latter are arranged lamps, L, motors, M, or other devices for utilising current. The elevated terminal, D', connects with the centre of the coil, A, and the other terminal of said coil is connected to earth, and preferably also to the coil C', for the reasons above stated.

The length of the high tension coil of each apparatus should be approximately one quarter of the wave length of the electrical disturbance in the circuit, this estimate being based on the velocity of propagation of the electrical disturbance through the coil itself, and the circuit with which it is designed to be used. To illustrate this in accordance with accepted views, if the rate at which the current traverses the circuit, including the two high tension coils, be 185,000 miles per second, then a frequency of 925 per second would maintain 925 stationary waves in a circuit 185,000

miles long, and each wave would be 200 miles in length. For such a frequency Tesla would use in each high tension coil a conductor 50 miles in length, or, in general, with due allowance for the capacity of the leading wires and terminals, such length of conductor as would secure the highest electrical pressures at the terminals under the working conditions.

It will be observed that in coils of the character described, the potential gradually increases with the number of turns, and the difference of potential between adjacent turns is comparatively small, and a very high potential, impracticable with ordinary coils, may be successfully maintained.

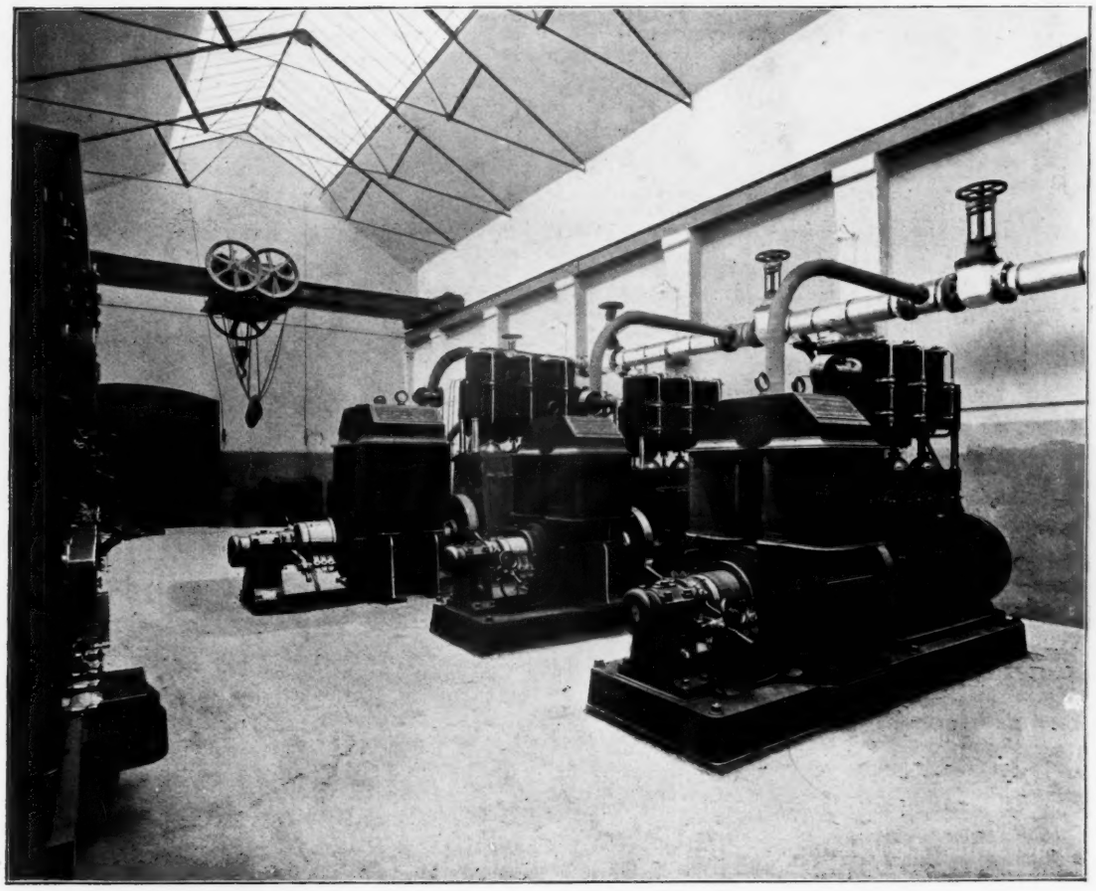
As the main object of the invention is to produce a current of extremely high potential, this object will be facilitated by using a primary current of very considerable frequency. But the frequency of the current is, in a large measure, arbitrary, for if the potential be sufficiently high and the terminals of the coils be maintained at a proper elevation where the atmosphere is comparatively rarefied, the intermediate stratum will serve as a conductor for the current produced, and the latter will be transmitted through the air with, it may be, even less resistance than through an ordinary copper wire.

As to the elevation of the terminals D, D′, it is obvious that this is a matter which will be determined not only by the condition of the atmosphere, but also by the character of the surrounding country. Thus if there be high mountains in the vicinity, the terminals should be at a great height, and generally, they should always be at an altitude much greater than that of the highest objects near them in order to reduce the loss by leakage. Since, by the means described, practically any potential that is desired may be produced, the currents through the air strata may be very small, thus reducing the loss in the air.

Tesla points out that the phenomenon involved in the transmission of electrical energy is one of true conduction, and is not to be confounded with the phenomena of induction or of electrical radiation which have heretofore been observed and experimented with, and which, from their very nature and mode of propagation, would render practically impossible the transmission of any considerable amount of energy to such distances as would be of practical importance.

FOLKESTONE ELECTRIC LIGHT STATION.

The Folkestone Electricity Supply Company, whose well-equipped works near Shorncliffe station were officially opened on Wednesday, November 2nd, is working under powers transferred from the local authority, who were not prepared to carry out the work themselves, owing to a want of unanimity amongst the members.



General View of Dynamo and Engine Room.

The transfer was only executed last November, and the first sod at the works cut in the first week in February; but by March 27th, a supply from partly temporary plant was given to an important consumer, and a general supply by July 1st. Since that date the demand has grown very rapidly, the equivalent of nearly 10,000 8-C.P. lamps being now connected and applied for. These include the lighting of most of the chief hotels, and many private residences.

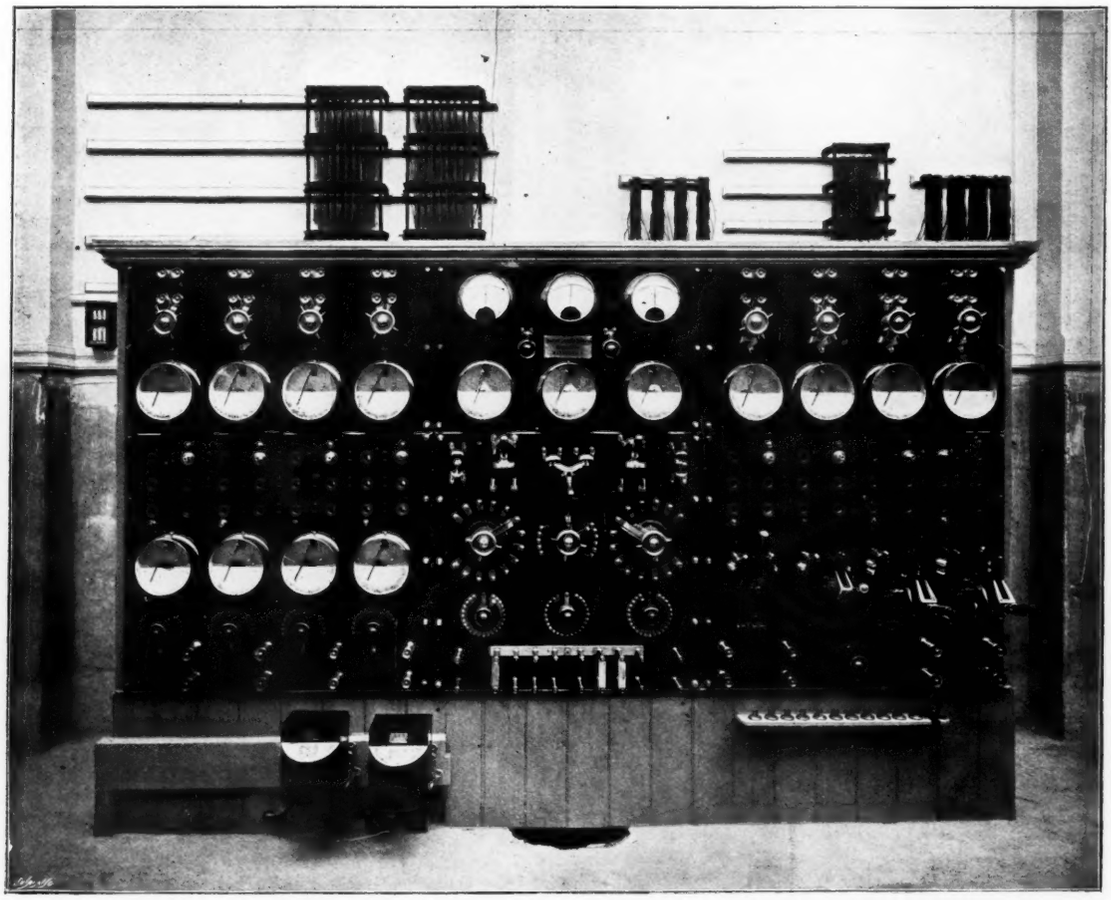
The prospectus of the company was issued in March, and the share capital was considerably over subscribed. The capital expenditure amounts to about £83 per kilowatt, which is very reasonable, considering that it is a low tension station, situated over a mile and a half from the centre of its area.

The whole of the contract for the establishment of the

undertaking was placed with Messrs. Edmundsons' Electricity Corporation, who designed the arrangements of the buildings, works, and mains, and carried out the entire work. Messrs. Lacey, Clirehugh & Sillar were called in to advise the local company upon the contract, and to supervise the execution of the work.

On behalf of Messrs. Edmundsons, Mr. J. C. Wigham acted as superintending engineer, Mr. Thomas Hesketh being the resident; the services of the latter gentleman have now been secured by the Folkestone Company as their engineer and manager.

As usual in a residential town, considerable difficulty was experienced in securing a site, most of the land being only available for building private dwellings. Eventually Lord Radnor, who is the owner of the greater portion of the newer part of Folkestone, kindly agreed to sell the company the present site, which is eminently suitable in all respects, except its great distance from the centre of the town.



Switchboard.

About 1½ acres of ground were secured, which will leave ample room for extensions of the buildings. The buildings were erected by Mr. D. Baker, builder, of Folkestone, under the supervision of Mr. Reginald Pope, architect. They are very commodious, and while not ornamental, are pleasing in appearance, substantial, and well suited for the purpose for which they are required.

The works are situated alongside of the South-Eastern Railway, close to Shorncliffe Station, and have a private siding, from which the coal is delivered straight into the coal bunkers, which have a capacity of about 150 tons, and being placed close enough to the boilers to allow of the coal falling out conveniently for feeding into the furnaces, are fitted with a movable front to allow of the boiler tubes being drawn in case of repairs.

The coal bunkers are covered with the C.I. water tank, holding about 17,500 gallons. The boiler house and engine room are alongside each other, and next the engines are the accumulator room and private office, while at the end of the main buildings are the stores, workshops, lavatories and public offices.

The entire buildings are built of fireproof material, the roof being entirely constructed of steel, slate, and glass, the slates being fastened to the angle iron purlins by lead clips; expanded steel lathing is attached to the inside of the engine room roof and plastered, giving the roof a very light and finished appearance.

An overhead hand crane, made by Messrs. Isles, of Stanningley, and capable of dealing with 8 tons, travels the length of the engine room.

There is enough room in the present buildings for as much plant as will allow of dealing with 15,000 lamps in use at once, and every provision is made for extending the buildings later.

No economiser is fitted at present, but space has been left for it if it is afterwards desired to erect one; it is, however, considered doubtful whether an economiser is of much use with economic boilers, and where an exhaust steam feed water heater is in use.

A 7½-inch steel tube has been sunk 180 feet for water, and a good supply has been obtained standing at about 86 feet, which is, of course—Folkestone being in the chalk district—very hard, but this will be treated by boiling, as described later.

The chimney, which is square and of an ornamental type, somewhat after the style of Messrs. Doulton's chimney in Lambeth, is 150 feet high, with 49 square feet area at the narrowest part. It is lined with firebrick about one-third of the height. The chimney was built from the inside, and an electric motor, used to lift all the material used, and also the workmen to and from their work, proved useful and exceedingly economical. It drove an ordinary winch by belting and friction gear.

There are at present three boilers in place of Messrs.

Davey, Paxman & Co.'s economic type, 14 feet × 8 feet diameter, space being left in the boiler house for erecting two others as the demand grows. Each of the boilers is capable of evaporating 6,000 lbs. of water per hour, and work at a pressure of 150 lbs.

Two of the boilers which were for a time used with a temporary chimney, are fitted with Meldrum's forced draught.

The steam pipes arranged on the usual ring main system are of 7-inch steel with copper bends, with 5-inch steel connections to the boiler and 2½-inch and 3½-inch copper connections to the engines. The main piping is drained at the ends of the ring to Geipel steam traps, and connections for drains are also fitted at the foot of the separators on the engine beds to similar drains. The steam being continually connected to these separators, dry steam is always available for starting up any engine.

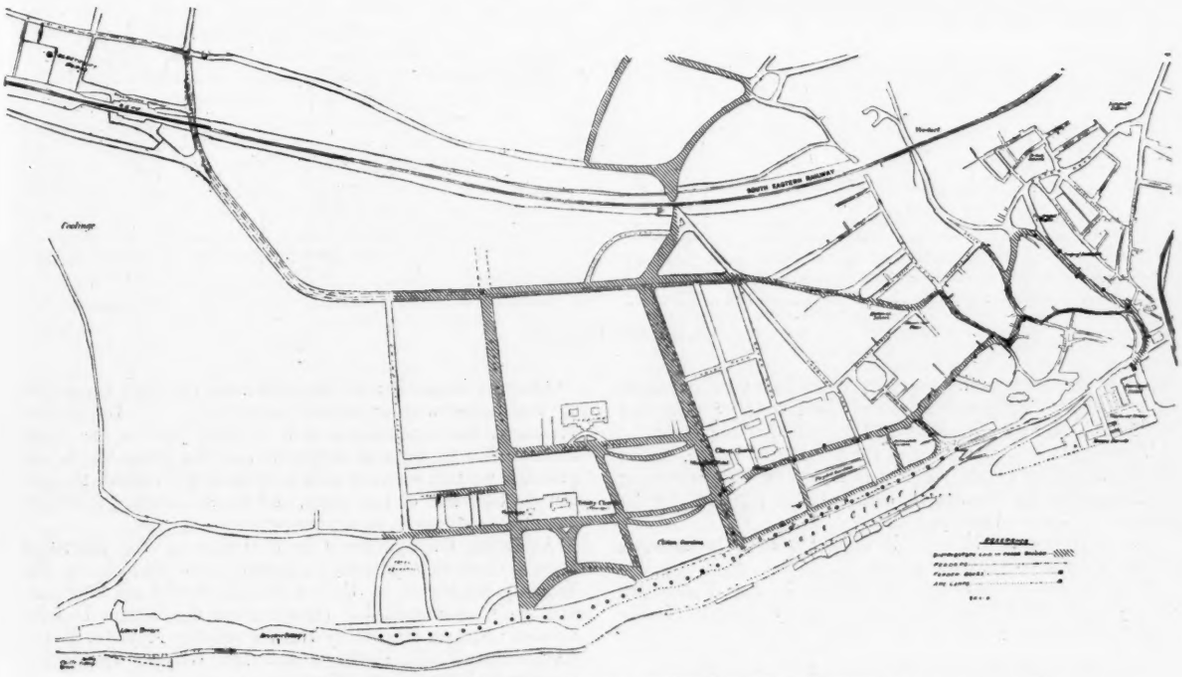
The valves throughout are of Hopkinson's own make.

There are at present three engines in use, of Messrs. Davey, Paxman & Co.'s "Peache" type, two being of the F.C. size, giving 120 B.H.P., with steam at 140 lbs. at the stop valve, and running at 480 revolutions per minute, and one of the purifying 12,000 lbs. of water per hour. The arrangement of this heater is, that the exhaust steam bubbles up through the water, causing it to boil, and depositing the salts of lime in the heater, which is made in eight parts, arranged for easily taking asunder for cleaning; a small quantity of solution of washing soda is injected into the feed water by a small pump attached to the pump for the purpose of treating the sulphates in the water. By means of this apparatus the water will pass into the boiler with not more than 2° or 3° of hardness and at boiling point.

The trouble arising from the grease in the steam passing into the feed water is overcome by the fact that the lime, when being precipitated by boiling carries with it all the particles of oil held in the water, leaving it perfectly pure.

The dynamos are by Thos. Parker, Limited, the smaller ones having an output of 160 amperes and the larger of 380 amperes, at 420 to 460 volts, and are of their usual well-known two-pole type, with steel magnets and the Eickmeyer winding of the armature.

The switchboard, made by Mr. Edmund Charrington, is in its main characteristics of the type now so frequently seen in a low tension station, being made of enamelled



Map of District Lighted. Station at Top Left-Hand Corner.

J.C. size, giving 246 H.P. at 375 revolutions per minute. A second large engine is already in hand, and is expected to be in place before the end of the year.

These engines are single acting three-crank, compound with six cylinders, and run silently, and with very little vibration.

The two three-throw feed pumps, electrically driven, were made by Messrs. Hayward Tyler & Co., and are capable of delivering 12,000 lbs. per hour when running at 43 revolutions per minute, and are fitted with gun-metal plungers to pump hot water. They are driven by two Parker motors, with double reduction spur gearing, having raw hide teeth in the pinions to insure silent running. Resistances and switches are fitted to allow of the armatures being supplied at 210 or 420 volts, giving two speeds, at which the motor will work economically; further regulation is obtained by inserting resistance in the field circuits, and finally by inserting resistance in the armature circuit.

The feed piping is arranged in duplicate with two connections to each boiler, with the requisite number of Hopkinson's valves to isolate any pump or any portion of the piping in case of failure.

The pumps can either be supplied with cold water from the supply tank, or with hot water from the feed heater.

The exhaust steam from the engine is led to one of William Boby's heater detartarisers, capable of heating and

slate supported on a steel frame, a moulding round the edge being the only wood work near the board. It is fitted with ammeters and duplex cut-outs on the feeders, and ammeters and auto cut-outs on the dynamos, the two being connected together by a plug board having three bus bars at the back of the board.

The centre panel of the board is that connected with the middle wire of the feeders and the centre cells of the accumulators, and is of Messrs. Edmundsons' standard type.

It contains a 14-way regulating switch for each side of the battery, a throw-over switch by means of which the cells are connected to the bus bars direct or through the armature of the booster. Two other throw-over switches are for the purpose of exciting the field circuit of the boosters, and short-circuiting the same immediately the circuit is broken, thereby preventing an abnormal rise of pressure in the winding.

The remaining switch is a double-pole for starting the balancer, and is interlocked with a resistance-switch. On the upper panel are the battery ammeters, the middle-wire ammeters, and three zero indicators, for putting the dynamo or boosters in parallel.

As we believe the use of these zero instruments is novel, it may be interesting to know that they are simply low-reading voltmeters, but made to withstand a high pressure, and

having the zero in the centre of the scale, they are connected to the poles of the switch it is desired to close when the potential of both machines is the same, and which the attendant closes when the needle comes to the centre point, the potentials being then equal. A simpler arrangement for paralleling could hardly be.

The only voltmeters employed are those on the pilots from the feeding points, which are of Lord Kelvin's engine room type. The electrostatic standard voltmeters, and all the ammeters and zero indicators on the board, are also of the Kelvin type. The voltmeters are placed on the end wall of the engine room, so as to be visible from all points.

The balancer booster set fixed at the end of the engine room is of Messrs. Parker's make, and similar to that supplied to Messrs. Edmundsons for Winchester (see ELECTRICAL REVIEW for July 8th), High Wycombe, and several other works.

Thomson-Houston meters are fitted on the output of the main dynamos, and Aron meters fitted with Millar's arrangement of single dial on the accumulators.

There are 230 accumulator cells of the D.P. type in glass boxes, of 715 ampere-hour capacity, erected on wooden stands in two tiers. They are capable of discharging 80 amperes at 420 volts for nine hours or 119 amperes for four hours.

The supply is at 210 volts at the consumers' lamps, and as the dynamos are wound for 420 volts, the current returning to the station by the middle wire is either taken up by the balancer or by the battery.

The charging of the cells is done through the boosters which add the required extra voltage.

Perhaps the most noteworthy point in the Folkestone supply undertaking is the extraordinary length of the feeders, which are:—

No. 1.	1,592 yards of ·2, ·1, ·2 inches triple concentric.	
No. 2.	2,563 yards of ·4, ·2, ·4	„ „
No. 3.	3,434 yards of ·4, ·2, ·4	„ „

The distributors laid are:—

1,174 yards	... ...	·100	·062	·100
9,955	„	·075	·060	·075
1,802	„	·050	·035	·050
2,761	„ (Arcs)	·012	·012	·012

These cables are composed of three conductors laid up into a strand, which allows of a much simpler service connection than if concentric be employed.

All the cables are Messrs. Callender's jute insulated lead covered and armoured, and laid direct in the ground.

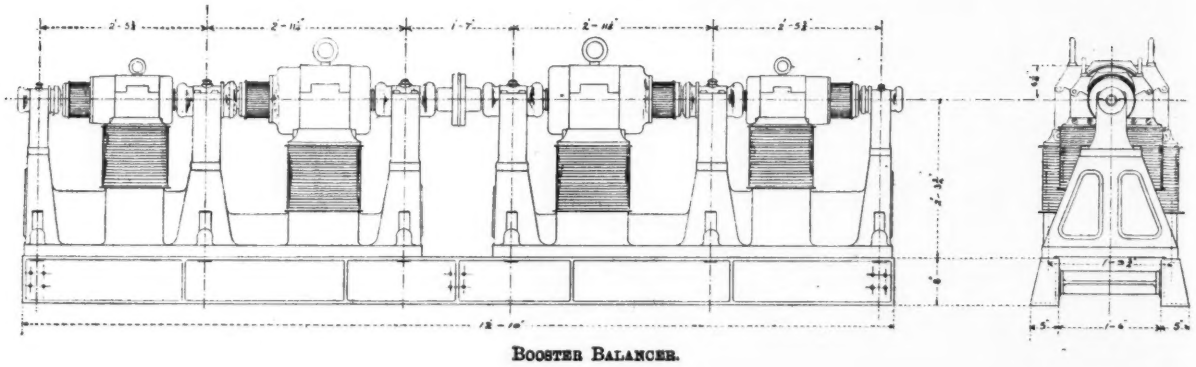
Three-core pilot wires, to the extent of 8,000 yards, are led back from the feeding points.

The feeder, network, and service boxes are of Messrs. Callender's well-known type, the ends of the fibrous insulation on the cables being sealed by being buried in compound.

There are at present being erected for street lighting 64 arc lamps of Johnson & Phillips's make, 10-ampere 14 hours single carbons, arranged in series of eight, and connected across the outers of the system; there are two incandescent lamps of 25 C.P. on each post for use after 11.30 p.m. As the designs of post selected by the Corporation have very small chambers in the base, only the isolating switches and substitutional resistances for each individual lamp are placed therein. The line switches and resistances are contained in pillar boxes similar in appearance to the boxes used for the line switches of an electric tram system. Each of the five switch pillars are arranged for three circuits, although there are only eight circuits in use at present.

In these pillars there is plenty of room for the switches, &c., and no trouble is likely to arise from the awkwardly crowded arrangement which would have been entailed if the switches were placed in the base of the lamp columns.

What happened before the Folkestone Electric Light Company came upon the scene was shortly as follows:—After the authorities had been approached in the usual way by a number of companies anxious to carry out the lighting of the town, a scheme was prepared by Mr. Mark Parker proposing to spend about £35,000, and was advocated by one section of the Corporation, but was defeated. The other side then brought in a scheme prepared by Mr. Medhurst proposing to spend about £15,000, which was, of course, quite inadequate for such a town as Folkestone, and this was also defeated, and they then decided to transfer their Order to a private company (the present company), to be formed by Mr. Hopkins, who is one of Edmundsons' directors.



BOOSTER BALANCER.

After an inspection of the works, the company proceeded to the luxuriously appointed dining room of Burlington Mansions for luncheon, and it is only just to the hotel management to say that it deserved all the praise which the gratified visitors were not slow in awarding. Indeed, the all-round excellence of the menu, and the attendance, would be hard to surpass even in the metropolis.

Alderman G. Spurgen (the chairman of the Electrical Supply Company) presided, supported on the right by His Worship the Mayor of Folkestone (Lieut.-Colonel Penfold), and Mr. C. Sisterton, J.P. (chairman of the Bognor District Council), and on the left by His Worship the Mayor of Hythe (Alderman H. T. Corbay), and Mr. Gripper (managing director to Edmundsons' Electricity Corporation).

Amongst other prominent gentlemen were Aldermen Banks, Slater, and Pledge, Councillors Jones, Peden, Dunk, Carpenter, Baker, Vaughan, Pursey, Hall, and Jenner, Col. Blake, and Messrs. Hopkins, Charrington, Hesketh, Pressland, Lacey and Clirehugh. There was also one medical man to two ordinary guests in case of need, a remarkable tribute to the excellence of the luncheon.

The Mayor of Hythe proposed the toast of "The Mayor and Corporation of the Town of Folkestone."

The Mayor of Folkestone, in response, said they were all proud of their town, and the inauguration of the electric lighting was certainly a red letter day. It was absolutely necessary, whatever they might individually think on the subject of electric light, that a town with the prestige Folkestone was supposed to have, must not be behind other places, but must be in the forefront.

Alderman Banks, in proposing the toast of "Prosperity to the Folkestone Electricity Supply Company," said he had no reason to do doubt but that the career of the Electrical Supply Company would be attended with success. "There is something more," he went on to say, "I may say on behalf of the Gas Company, that they have no ill-feeling whatever against them. The shareholders of the Gas Company hope, and so do I, that these two companies will work together hand in hand to carry out their work, and do all they can for the prosperity of their shareholders. With regard to the Gas Company, I hope they will continue to pay their shareholders the

maximum dividend. I hope the Electrical Supply Company will do the same. I don't know whether there is any limit to their dividend, but I always hope that they will pay their shareholders a proper, fair, and reasonable dividend." Mr. Banks concluded by coupling with the toast the name of Alderman Spurgen, the chairman of the company, and Mr. Gripper (the managing director).

Alderman Spurgen, in responding, said he should like to take Alderman Banks at his word when he said that he hoped the two companies—the Electrical Supply Company and the Gas Company—would work together hand in hand. They were a poor struggling company just commencing. They had 75 consumers; he did not know how many the Gas Company had (Alderman Banks—7,000), but he would suggest to the worthy Alderman that he should hand over a certain number of consumers to the company just to prove his goodwill and desire to help them. With regard to the establishment of the company—that was almost a question of ancient history. It was a good many years ago since the question was first considered. He traced the earlier attempts which were made to introduce an installation of electric light into the town, and the various phases through which the question passed to the time when the Corporation took the matter up on April 19th, 1893, when a committee was formed to consider the question of electric lighting for Folkestone. That committee presented their report in January, 1894. The scheme then prepared was thrown out, and another committee was appointed in September, 1894, eight months after the first committee's report had been thrown out. The second committee submitted a smaller scheme, which was known as Mr. Medhurst's scheme. He noticed that in Mr. Medhurst's scheme it was proposed to supply 4,500 8-candle-power lights and 28 arc lamps. In connection with that he would mention that to-day with their works in an incomplete state as they had seen them they were supplying 8,700 8-candle-power lights and 24 arc lamps. This showed the futility of adopting the scheme prepared by Mr. Medhurst. They had the nucleus for the installation of a town of almost any size, and Mr. Gripper would tell them that this could be extended to almost any capacity. This was little short of marvellous, when they considered that it was only in October last that they made the contract with Messrs. Edmundsons. The transfer they did not get till last November, and this time last year they were negotiating with Lord Radnor for land for the station. They had lost no time, and even then they had to start supplying customers from a little wooden shed before they got the walls built up round the machinery. He thought this said something for the enterprise of the company. They did not desire to damage or harm anyone, and nothing was further from their minds than the thought of acting antagonistically towards the Gas Company.

Mr. Gripper, in the course of his remarks, said Folkestone had left the adoption of electric lighting till rather late in the day, but through this delay they had been able to reap the benefit of a more perfect and economical system of installation. The towns that went in for it in its earlier stages had to pay for it, and Folkestone was now reaping the benefit of their experiences. The company were in a position to supply electric light on the best system, and at the lowest price at which it could be supplied. They did not want to rush into violent competition with the Gas Company. There was plenty of room for both of them in Folkestone.

The secretary, Mr. Hall, rising, said he believed a career of great success lay before the company. They had over 300 shareholders, and amongst that number 110 were residents in the town. That was saying a great deal. Out of a capital of £50,000 the directors and friends subscribed £25,000, and when the remaining £25,000 was opened to the public they received applications amounting to over £50,000. The amount expended in public advertising, printing, &c., did not come to more than £50. The shares had never been sold at a discount, and if any of the shareholders wished to part with them now, he believed they could do so at a premium of £1 per share. He asked them, however, to take his advice and hold them, for they would increase considerably in value as time went on.

Mr. W. D. Barnett gave the toast of "The Visitors," coupling with it the name of Mr. Sitterton (chairman of the Bognor District Council).

Mr. Sisterton, in response, complimented Folkestone upon the very great progress it had made since his last visit to the town some three years ago, and to-day, now that they had inaugurated electric lighting, Folkestone was entitled to rank as one of the most beautiful and interesting towns in England.

The Chairman proposed the health of Mr. Lacey, "the consulting engineer to the company," under whose supervision the works were carried out. He understood from Mr. Lacey that day that he was perfectly satisfied with the way in which the work had been carried out. In Mr. Hesketh, their own engineer, whom they took over from Messrs. Edmundsons, they felt that they had got a very excellent man at the head of affairs, and who thoroughly understood his business. He hoped the station would be a great success and reflect high credit upon Mr. Hesketh.

Mr. Lacey suitably responded, saying that out of 100 electric supply companies which had sprung into existence, they all, with only two or three exceptions, had paid from 6 to 12 per cent. The latter he trusted would be Folkestone's portion.

As at Winchester everything bears the stamp of Messrs. Edmundsons' excellent methods, and Folkestone will doubtless reap the reward of good engineering and sound finance.

CONTRACTS OPEN AND CLOSED.

(*Continued from page* 708.)

CLOSED.

Belgium.—The contract for the supply and erection of a complete installation of electric lighting in the new Flemish theatre in Ghent, including the generating plant has been very keenly competed for, no less than 12 tenders being received for the work, comprising six from Belgian firms, four from German firms, one from an English company, and one from a Paris concern. The lowest tender was that of M. A. Jaspar, of Liege (£3,501) while the highest was that of Messrs. Laing, Wharton & Down, of London, £6,850. This is the first time over a long period that we have seen an English firm competing for Continental contracts, but it will be seen that there was a considerable difference in favour of the native concern.

France.—The French Post and Telegraph authorities in Paris have just placed a contract for 20 tons of high conductivity copper wire, 2 mm. diameter, with La Société des Forges de Franche-Comte, at £1,240, and for 20 tons ditto. with Messrs. Lazare Weiller and Co., of Paris, at £1,254.

Hammersmith.—The Vestry on Wednesday resolved to order an additional engine for the electricity works from Messrs. Robey & Co. at the same price as last, £2,305. An order has been placed with Messrs. Ferranti for a 300-kw. dynamo at £1,900, to be ready within five months.

St. Helens.—The Corporation has accepted the tender of Messrs. Yates & Thom for the supply of a new boiler for the electricity works. A number of firms tendered.

FORTHCOMING EVENTS.

Friday, November 11th.—At 5 p.m. Physical Society. At the rooms of the Chemical Society, Burlington House. Agenda: (1) Discussion on Mr. A. Campbell's paper on "The Magnetic Fluxes in Meters and other Electrical Instruments," to be opened by Prof. W. E. Ayrton, F.R.S.; (2) "On the Propagation of Damped Electrical Oscillations along Parallel Wires," by Prof. W. B. Morton, M.A.; (3) "On the Properties of Liquid Mixtures," by R. A. Lehfeldt.

Saturday, November 12th.—At 3 p.m. The Institution of Junior Engineers' visit to the King William Street station of the City and South London Railway extension works.

Tuesday, November 15th.—At 8 p.m. Institution of Civil Engineers. Paper on "Electrical Transmission of Power in Mining," by W. B. Esson, M.Inst.C.E.

Wednesday, November 16th.—Society of Arts. The opening address of the session by Sir John Wolfe Barry, K.C.B., LL.D., F.R.S., the chairman of the Society's council. Topic: "The Internal Traffic of London."

At 7.30 p.m. Institution of Electrical Engineers. The annual general meeting of the students' section, in the library of the Institution.

Friday, November 18th.—At 8 p.m. Institution of Civil Engineers, Students' meeting. Paper to be read, "Liquid Air: a short description of its Production, and summary of its Application to the Chemical or other Industries," by Cecil Lightfoot, Stud Inst.C.E. Mr. W. H. Preece, C.B., F.R.S. (president), in the chair.

Wednesday, November 30th.—At 4 p.m. Royal Society. Anniversary meeting. At 7 p.m.: annual dinner at Hotel Metropole.

Wednesday, December 7th.—Institution of Electrical Engineers. Annual Dinner, Grand Hall, Hotel Cecil.

NOTES

Electricity from Peat.—*Stahl und Eisen* contains an article in which the author, Dr. Frank, proposes to utilise the great peat beds of North Germany for the production of electricity on a large scale. He estimates that a hectare of turf, three metres thick, gives 2,500 tons of dry turf, equivalent to 1,200 tons of coke, or in English measure, an acre of turf, 10 feet thick, gives a 1,000 tons of dry turf, equivalent to 480 tons of coke. The mosses of the Evus valley, which cover an area of 1,000 square miles, might furnish the equivalent of 300,000,000 tons of pit coal; that is to say, more than the total production of Germany for three years. The turf would be burnt at central stations of 10,000 horse-power capacity, consuming annually 200,000 tons of turf, the product of 200 acres of the beds. One application of the power produced would be to the service of the canal connecting Dortmund to the Evus, which will soon be finished; but the author thinks the most interesting will be the manufacture of acetylene, the materials for which can be obtained easily and cheaply in the neighbourhood. With 10,000 horse-power, a quantity of acetylene can be produced daily equivalent for lighting purposes to 150,000 gallons of petroleum, or annually in value to 20,000 tons of foreign imported petroleum.

Enclosed Arc Lamp Decision.—The *Wall Street Journal*, New York, October 20th, contained the following paragraph:—"In the suit of the Marks Enclosed Arc Light Company, 687, Broadway, N.Y., *v.* Washington Mills Company, 74, Worth Street, N.Y., a decision has just been rendered in favour of the complainant. The suit was begun in the United States Circuit Court, September 10th, 1897, and the decree granted to the Marks Company by Judge Coxe on October 18th, 1898. The patent infringed is No. 520,996, of Marks & Ransom, dated June 5th, 1894. This patent broadly covers the method of operation used in all modern enclosed arc lamps. The Washington Mills Company were users of the Kinsman lamp, sold by the Electric Construction and Supply Company, 27, Thames Street, N.Y. The decision peremptorily stops the sale of unlicensed enclosed arc lamps by the Kinsman Company, and also involves the payment of damages by the defendant. This decision is understood to be unfavourable to the General Electric."

Plagiarism!—The editor of the *Digest of Physical Tests*, of Philadelphia, announces that the publication of that journal has been temporarily suspended. Perhaps this is just as well, if its usual practice is to reproduce original articles from other journals without giving due credit. For instance, in the "suspending" issue, there is reprinted from the ELECTRICAL REVIEW of July 10th, 1896, a 5½-column original article by ourselves on "Some Notes on Rope Driving." The editor appears to have thought that as it was 2¼ years old he was at liberty to do a little plagiarism. The Philadelphia editor is not the only offender in this direction. More than one of our home contemporaries, much to their discredit, occasionally draw, free of charge, upon the columns of the ELECTRICAL REVIEW.

Harness Redivivus.—The following cutting from the *Lincoln Mercury* of November 4th is significant:—

C. B. Harness's Electropathic Belt is the only genuine and well-known curative appliance. Recommended by thousands of sufferers amongst all classes of society as the reliable relief and cure for rheumatism, gout, sciatica, nervous exhaustion, &c.—Send for Book of Testimonials (post free) to the Medical Battery Company, Limited, 489, Oxford Street, London, W.—*Advt.*

Technical Education and Industrial Developments in France.—We do not in this country pay much attention to the educational methods or institutions of France, but even France is ahead of us in the matter of technical education. While we in England still lack a public college or technical school in which an extended and thorough course of instruction in electro-chemistry is possible upon the lines of those carried out at Aachen and Darmstadt in Germany and Zurich in Switzerland, France has lately provided such a training institution at Grénoble in Savoy. Visits to power installations and to works will form an important feature of the curriculum, and the suitability of Grénoble for a technical college in which applied electricity is the chief study, is proved by the fact that in the immediate neighbourhood there are 16 lighting installations, chiefly driven by water-power, 15 power transmission schemes, and 12 electro-chemical or electro-metallurgical works in operation. Nearly 20,000 H.P. is said to be utilised in the latter.* The valleys of the Rhone and of the Saône thus threaten to become one of the most important chemical manufacturing centres in Europe, and in years to come this district may rival the similar districts of South Lancashire in the number and magnitude of its chemical and metallurgical works. In South Lancashire a cheap and plentiful fuel supply was the determining factor in establishing the prosperity of the district; in Savoy and Dauphine it is a plentiful supply of water capable of cheap exploitation for power purposes that is building up the industries of the eastern provinces of France. But in these modern days cheap power alone will not suffice to ensure success to any commercial undertaking, and the newly-founded technical college at Grénoble will provide the trained *heads and managers* for the industries carried on in the neighbourhood.

Micro-photography in Colours.—The progress made in the study of the structure of metals and alloys by the art of micro-photography has led to the further attempt of reproducing in a picture the colours as well as the general character of the constituents. Those who have experimented in this direction will know that it is impossible to indicate by a black-and-white *gravure* one half of what the eye sees in examining the specimens; moreover, they will remember that unless isochromatic plates are used it is extremely difficult to obtain satisfactory negatives. M. Monpillard, in the *Revue Générale des Sciences*, October 15th, 1898, describes a method of applying the principle suggested in 1868 by Cros and Ducos, of successively photographing the object through coloured screens of red, yellow, and blue glass. Special care is taken to use screens of the proper selecting power. They are formed of gelatine, and consist of thin pellicles of blue-violet, green-yellow, and orange-red; respectively selecting yellow, red, and blue. In some cases two screens only are necessary. The article is illustrated by a beautiful example of colour-photography applied to micro-sections of organic substances.

Refuse Destructors.—At the monthly meeting of the Leeds Association of Engineers, on October 27th, the president (Mr. William Sheldon) in the chair, a paper was read by Mr. F. Leslie Watson, A.M.Inst.C.E., on "The Designing and Construction of Refuse Destructors." In the discussion which followed, Mr. H. Vernon said that for electric tramways great inconvenience would be involved in carting refuse from various parts of the town to a central generating station. Mr. G. W. Blackburn saw no difficulty in conveying the current along mains from various destructor plants to a central station. Mr. J. C. Moorhouse advocated the use of the backs of kitchen fires as auxiliary destructors. It was a bad practice to throw green garbage into ash pits in a moist state. There would also be a difference between the clinker formed and the heat produced from refuse in a wet condition and dry ash. After others had spoken, Mr. Watson, in replying, said that the scrapings off macadamised roads was about the only kind of refuse which could not be utilised.

Marriage.—Mr. G. S. Peck, the resident engineer of the Scarborough Electric Lighting Company, was married on 2nd inst. to Miss Annie Holden, of Southport.

* *L'Eclairage Electrique*, July 30th, 1898.

Street Traction v. Surface Contacts.—We cull the following editorial remarks on this question from the New York *Electrical World*:—"Objections to the overhead trolley on the score of appearances, and to the open conduit on the score of expense, will undoubtedly give a tremendous demand for the first really successful closed conduit or sectional conductor surface contact system. Each such system requires a switch for every few yards of track, and the one essential requirement to success not yet fulfilled is the high degree of reliability of this switch. The tendency in this line, as evidenced by Patent Office records and a few practical trials, is toward a switch operated by an electro-magnet, and a device of this type, interesting because of its ingenious novelty, is described in a paper read before the British Association by Prof. S. P. Thompson. Mercury contact is used, and the break is made under oil. The switch itself seems to have the desired element of simplicity, but the complete arrangement is open to several criticisms. Among them is that which applies to all systems depending for their operation of the electro-magnetic switches on current supplied from the power house, which is that, once the car has become disconnected from the source of power for any reason whatever—as an imperfect contact or faulty switch—it is henceforth helpless and cannot operate the next or any switch in advance. The opening of a circuit breaker at the power station would, with such a system, render every car absolutely helpless and unable to get further communication with the live feeder. For this reason, any system dependent on electrically operated switches to be worthy of serious consideration must carry on the car a source of current—preferably storage batteries. This, also, unless of 500 volts' pressure, necessitates another auxiliary rail or set of contact buttons to conduct the low-voltage current to the switch magnets. The switch described has an ingenious arrangement for grounding its exposed contact in case it fails to open the circuit when the car leaves it. Unfortunately, this grounding device provides only for the inaction of one of its two moving parts, and in case both fail to restore to the normal position, the exposed contact may remain 'alive.' A better device, which has often been proposed in this country, is a simple grounded contact carried by the car and following at a proper distance the main shoe or skate, this grounded contact absolutely short circuiting the line through any switch which may fail to open when the car leaves it. The study of these switches is valuable on the part of electric railway designers, as it is more than probable that, by a combination of the good elements of the many imperfect devices designed, there may soon be attained a switch sufficiently reliable for the successful operation of surface contact roads."

Institution of Electrical Engineers.—A special general meeting of members was held on November 3rd to consider the draft of revised Articles of Association. So far as we can see the chief new feature is a clause which relates to the formation of a new class of members to be called Associate Members. The article reads as follows:—

13. *Associate Members.*—Every Associate Member shall be either an electrical engineer or electrician, and shall be at least 25 years of age, and, whether admitted by election or by transfer, shall come within one of the following descriptions:—

(*a*) He shall have been on the Register as an Associate on December 31st, 1898; or

(*b*) he shall have been educated as an electrical engineer or electrician in a manner which shall satisfy the Council, and either (1) he shall have had subsequent employment for at least two years in a responsible situation as an electrical engineer or electrician, and shall be actually engaged in such a situation at the time of his application for election or transfer; (2) he shall have been engaged for at least five years in one of the branches of electrical engineering, and shall be actually so engaged at the time of his application, and shall afford satisfactory proof to the Council of his fitness for election; or (3), being an Associate, he shall have gained a premium in any year for a paper read at an ordinary general meeting of the Institution.

There is also an interesting article relating to diplomas as follows:—

10. Subject to such regulations as the Council may from time to time prescribe, the Council may issue to any Member or Associate Member a certificate showing the class to which he belongs. Every such certificate shall be according to the form F in the schedule, or such modification thereof as may from time to time be approved by the Council, and shall remain the property of, and shall on demand be returned to, the Institution.

Electrical Works in Germany.—In an article on German trusts and combinations, the Berlin correspondent of the *Financial Times* says that the great event of last week was the formation of a formidable ring of German electric works, following immediately upon the fusion of the greatest German coal concern, "The Centrum," with the Harpener Association.

The sudden appearance of such powerful trusts absorbs the entire attention and interest of the market. An epidemic of rings and trusts has suddenly set in here. The fusion of the banks is followed by the fusion of the biggest German industrial concerns. Harpen-Centrum is now succeeded by Ludwig Loewe-Union-Schuckert, the three greatest electrical concerns of Berlin and Nuremberg. The latest fusion came as a real surprise to the Berlin market. This tendency towards gigantic centralisations of capital indeed caused a mild shudder to run through the Bourse. The economical objections to such amalgamations were fully appreciated, and after a short rise the stocks of the concerns, more or less affected by these fusions, fell again considerably. The details of the latest amalgamation are as follows:—Ludwig Loewe & Co. increase their capital from 7½ million marks nominal to 40 million marks nominal by issuing 32½ million marks of new shares, with dividends accruing from January 1st, 1899; Schuckert & Co. receive for their 28 million marks nominal shares, 14 million marks nominal shares of the new Loewe issue, and 100 marks for each Schuckert share as an equivalent for the nine months' Schuckert dividend. Ten million marks of the new issue are offered to the shareholders at the rate of one new share for two old ones. The remaining 7½ millions are taken up by the bank group associated with the concerns. The Continental Electrical Works increase their capital to 50 million marks by the issue of 20 million nominal new shares. The details of this, which is by far the biggest industrial financial transaction ever known in Germany, are so intricate that it is difficult to form as yet a judgment on their merits. But it seems as if the lion's share had been secured by Ludwig Loewe & Co. and its banking groups. Nevertheless, as I remarked above, Loewe shares dropped from 512 to 503. The banks connected with the transaction—the Disconto Bank and the Dresdner Bank—profited to the extent of about 2½ points.

Personal.—The Queen of Spain, acting for King Alfonso, has conferred on Mr. Charles Alexander Gerhardi, the manager of the Direct Spanish Telegraph Company, the honour of Commander of the Order of Isabel la Catolica. Mr. Gerhardi has been connected with telegraphy for close on 50 years, having been present on board the United States steam frigate *Niagara* at the attempts to lay the first Atlantic cable in 1857, and at the final laying of that cable in 1858. In 1860 Mr. Gerhardi was appointed by the Submarine Telegraph Company as superintendent of their Channel Islands cable, and later on was put in charge, in London, of the Belgian, Dutch, and German cables. In 1872 he was appointed manager of the Direct Spanish Telegraph Company, which had just then been formed, and which he has continued to manage up to this date. We heartily congratulate Mr. Gerhardi upon his new decoration.

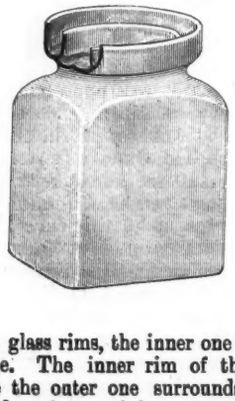
We may also mention that the Spanish Government has conferred the Order of Isabel la Catolica on Mr. A. B. Tonkin, who for many years has been connected with the Direct Spanish Telegraph Company.

Mr. A. H. Walton, the engineer for the past four years of the Metropolitan Electric Supply Company, has been appointed by the British Thomson-Houston Company chief engineer for the erection and maintenance of the electrical plant on the Central London Railway. He will superintend the equipment of the power house and sub-station, together with the locomotives, and when the line is in operation will act as chief engineer. It is, perhaps, hardly necessary to mention that Mr. Walton has had an almost unique experience in electrical distribution work. He has been closely allied with Mr. Frank Bailey for a good many years, and previous to being appointed acting engineer was chief assistant engineer to that gentleman on the Metropolitan Company. Mr. Walton was also associated with Mr. Bailey on the work carried out for the Great Western Railway Company by the Telegraph Construction and Manufacturing Company. We congratulate Mr. Walton on being appointed to a sphere in which his experience and knowledge will enable him to excel. The work he has been called upon to carry out is of the highest importance, and we trust that he will achieve complete success.

Paper.—Before the members of the Ipswich Scientific Society on Wednesday evening, Mr. H. V. Pegg, A.M.I.C.E., read a paper dealing with "The Disposal of Town Refuse: its Use as Fuel."

Electric Cranes.—At the Town Quay, Southampton, on Thursday afternoon last week an official trial of the four new electric cranes just erected by Messrs. Stothert & Pitt, of Bath, took place in the presence of the Mayor and other representatives of the Harbour Board. The cranes were designed by Mr. J. G. W. Aldridge, the Board's electrical engineer, and exhibit many important improvements over those which have been in use at the Town Quay for some time past, and which are also worked by electrical power, the current being supplied from the Corporation works. They are guaranteed to raise a weight of 30 cwt. at the rate of 200 feet per minute, and to slew at the rate of 400 feet per minute, both movements to be executed simultaneously. For three of the cranes the maximum load is 3 tons, and if at any time the weight attached should exceed that amount, or anything should go wrong, a warning bell is rung automatically. The fourth crane is constructed as a combination 3 and 12-ton one. With one set of gearing it raises loads up to a maximum of 3 tons, and in 2 minutes a mechanical change may be effected whereby the load can be increased to four times that amount. Each of the cranes travels on lines running to all points on the Quay, this movement being quickly effected by hand power. There are now in all six electric cranes on the Quay. The party afterwards took luncheon at Radley's Hotel upon Messrs. Stothert and Pitt's invitation.

Improved Form of Primary Battery.—The creeping of salts is one of the annoyances experienced in the use of primary batteries, to overcome which much time, labour, and money have been expended, while the results have not always been altogether satisfactory. Messrs. Meysenburg and Badt, Chicago, have, according to the *Electrical World*, met the problem in a very ingenious manner, as will be understood from what follows. The illustration shows the glass jar of the Badt hermetic cell, which is provided with a channel or trough around the upper edge of the neck, the



cover having two glass rims, the inner one being concentric with the outer one. The inner rim of the cover rests in the trough, while the outer one surrounds the top of the jar, and prevents dust from gaining entrance to the trough. The trough is filled with oil, thus furnishing an air-tight seal, which effectually prevents the creeping of salts. Another important advantage is the additional insulation from the jar and earth thus given to the electrodes, which are in turn insulated from each other by the glass of the cover.

X Rays in Hospitals.—In celebration of the gift of a Röntgen rays apparatus from the Duke of Newcastle, the committee of the North-Eastern Hospital for Children gave an "X rays" *soirée* to their friends at the hospital, Hackney Road, Shoreditch, on Thursday last week. Mr. J. Le Couteur, who lent two additional instruments for the occasion, showed the effects of the rays on a collection of rubies and other precious stones, demonstrating their use in the detection of imitations, while the resident medical officers gave interesting demonstrations with the powerful apparatus belonging to the hospital.

The River Plate New Institution.—We have received a copy of the articles of association of the Institution of Engineers of the River Plate. Mr. Ernest Danvers, of Buenos Ayres, is the secretary.

Fluorescent Screens for X Ray Work.—A contributor to the *British and Colonial Druggist* says, from personal experience, that effective fluorescent screens may be made by the amateur, and that a material reduction in cost is thereby effected. Calcium tungsgate he regards as a very fair material, and a salt of uranium he thinks very good (the particular salt not being mentioned). The method of making the screen is as follows: Take a plate of glass, say, 8½ by 6½ inches, make a mask of stout paper, with an opening 7 by 5; wet this mask with glycerine or mucilage of gum arabic, and place it over the plate; cover the plate with collodion or varnish, or mucilage (with a little glycerine added), and sift the powdered salt quickly and evenly all over the surface. If vellum, parchment, cardboard, or ebonite be used as the support, one may put a coating on both sides, and thus even up any inequalities of deposit; but with a glass support the same advantage will not accrue. Having got a good thick coating of powder, the mask is removed, but this does not matter very much; it has served its purpose to give a clear edge to the coating. The coated side, which must face the tube, if glass is used, is covered with a piece of thin black celluloid, or ebonite, or opaque paper. With vellum, parchment, or paper, there should still be a black shield between the tube and the fluorescent salt; but the latter should be left uncovered, and facing the eye. The platinocyanides may be used in the same way, though they do not powder nor sift so finely; or they may be mixed with varnish, and spread over a glass or vellum surface. The trouble is to get a really even coating, but with anything but glass one can apply a roller pressure, and thus smooth down any unevenness. The easiest way to get an even coating, according to the author, is to use a vehicle of paraffin and petrolatum. Equal parts of each are melted together, stirred until cool, and the powdered salt (about 2 drachms for a 7 by 5 screen) rubbed on a slab with just enough of the wax mixture to make a workable mass, which is spread by means of a long, straight spatula. An undesirable feature is the liability of the mixture to "run" in a heated atmosphere, but at normal temperature no trouble whatever is encountered. The author, whose article is abstracted in *Scientific American*, mentions that in addition to its value as a means of direct observation, the fluorescent screen reduces the time of exposure in making a skiagraph, being placed beneath the plate when exposed. In conclusion, the author remarks:—"Of course, it must be understood that even the best and most costly screen will not fluoresce to any extent if the rays are being delivered poorly and intermittently; it will not compensate for a poor and weak electrical discharge and faulty tube. As a gauge by which to estimate exposures, I consider a good screen very valuable. With practice one becomes as intimate with the capabilities of his 'tubes' as a photographer with the capacity, as regards covering power and rapidity, of his lens."

Society of Arts.—The arrangements for the 1898-99 session, which opens on 16th inst. with Sir J. Wolfe Barry's presidential address, include the following:—November 23rd, Prof. Geo. Forbes, F.R.S., on "Long Distance Transmission of Power." After Christmas, Mr. Philip Dawson on "Electric Traction and its Application to Railway Work," and W. H. Preece, C.B., F.R.S., on "Wireless Telegraphy." There are to be four Cantor Lectures by Prof. Vivian B. Lewis on "Acetylene," on November 21st and 28th, and December 5th and 12th. Dr. S. Rideal will deliver four Cantor Lectures on "Bacterial Purification of Sewage," on January 16th, 23rd and 30th, and February 6th.

Royal Institution.—A general monthly meeting of the members of the Royal Institution was held on 7th inst. The special thanks of the members were returned to Mr. John B. Carrington, for his donation of £25, and to Mr. Charles Scott Dickson, Q.C., Solicitor-General for Scotland, for his donation of £100 to the fund for the promotion of experimental research at low temperatures.

Appointment.—The Birmingham Technical School Committee last week appointed Mr. Thomas Reid, of Dundee, to the post of head teacher of the Engineering Department at the Municipal Technical School.

Interruption in Supply at High Wycombe.—Messrs. Edmundsons' Electricity Corporation furnish us with the following particulars of an interruption at High Wycombe:—About 10.30 on Wednesday, November 2nd, one of the feeders—a triple concentric lead-covered and armoured cable—broke down. The outer ring being the neutral conductor, was practically short circuited to the next ring, the negative blowing the fuse on the station end of the feeder, and also most unfortunately melting out the copper bridges on the neutral of all the feeders at the station, with the result that there was too great a pressure on the lamps on the positive side of the system, which burst a few lamps and fused some lamp holders and blew a number of fuses, which was the total amount of damage done. At the moment the supply was being given from the accumulators, and no one was in the works. Most of the supply was renewed a few minutes after the occurrence, and everything was in order the next evening. The breaking of the earth connection caused the fire alarm bells in firemen's houses to ring, which was the first intimation of trouble on the lighting circuits.

The Hawley Down-Draught Grate.—The smoke question has been much in evidence in France of late, and many types of furnace have been tested. The *Journal Universel d'Electricite* describes some tests on the Hawley down-draught grate at a works at St. Denis, when on a four months' trial a saving of fuel has been effected of 11·27 per cent. The smokelessness is absolute. The grate was tried in a Babcock type boiler constructed at Quillac. Anzin briquettes were used as fuel. On four tests an ordinary grate showed an evaporation of from 7·64 to 8·2, the Hawley grate showing 9·14 to 9·57, and an economy of 13·23 to 15·86 per cent. The mean economy per pound of combustible was 14·945 per cent. and per pound of coal 17·290 per cent. There are two grates, the upper one of water tubes and the lower one of ordinary type, on which is completed the combustion of the fuel which falls through the top grate. The larger proportion of air comes in above the top grate and passes down through the fire. Additional air may be admitted between the grates if required. Obviously the upper grate must be exposed to very severe temperatures, and circulation in the tubes of the grates must be copious, and the water supply should be good in quality. The upper grate acts as a sort of retort to ensure a considerable temperature to the gases evolved upon it, heated by passing through the fire bed below, while they are mixed with more air in the presence of of a hot clear fire on the lower grate. Properly arranged and worked, the Hawley furnace appears excellent for externally-fired boilers, but not practicable for internal furnaces, by reason of want of space.

Revision of Charges by the Edison Electric Illuminating Company of New York.—This company has recently decided to enter into more active opposition to the Gas Companies of New York, and in a circular issued to the public of that city, it has given the details of the new system of charging. For small consumers the charges are in future to be—10d. per kw.-hour for the first hour's average daily use of the total lamp equivalent connected; 7½d. for the second hour; 5d. for the third and fourth hours, and 2½d. for use above five hours. For the larger consumers, guaranteeing 2,000 kw.-hours' consumption each month, and two hours' average daily use of the installation, the charges are fixed as follows:—5d. per kw.-hour for first four hours' average daily use; and 2½d. per kw.-hour for all use above four hours. These charges cover both incandescence and arc lighting, and include renewals of incandescence lamps, and carbons, &c., for arc lamps. They do not include, however, first supply of lamps. If these revised charges lead to the increased use of electricity for lighting and other purposes which is anticipated by the company, a further reduction for long hour use is contemplated. In comparing these charges with those made by the London companies, it is necessary to remember that labour and raw materials are dearer in New York than in London, and that gas is also a much more costly illuminant than in this country. With gas at 2s. 7d. per 1,000 cubic feet, the revised charges of the Edison Electric Illuminating Company, of New York, would probably fail to win fresh consumers for the electric current.

Lectures.—Mr. W. H. Preece, C.B., F.R.S., on Monday, addressed the Carnarvon Literary Union on "Wireless Telegraphy."

On 3rd inst., Prof. Jamieson delivered the fourth of his series of lectures on "Electric Railways and Tramways," at the Glasgow and West of Scotland Technical College.

Obituary.—We regret to announce the death of a well-known French electrician, almost unheard of during recent years, M. De Meritens, which occurred last week at Paris, under very sad circumstances, at the age of 65 years. His name will be most familiar to electrical men in this country in connection with his celebrated magneto-electric generator, which was extensively tried about 20 years ago in many French and several English light-houses for illumination purposes.

NEW COMPANIES REGISTERED.

West Kent Electricity Supply Company, Limited (59,368).—This company was registered on November 2nd, with a capital of £20,000 in £1 shares, to carry on the business of electricians, mechanical engineers, suppliers of electricity and manufacturers of electrical apparatus, and to construct, lay down, establish, fix and carry out all necessary cables, wires, lines, accumulators, lamps and works. The subscribers (with one share each) are:—W. W. Pritchard, 39, King Street, Cheapside, solicitor; Joseph T. Rockett, 14, Westbury Road, Bowes Park, accountant; Harry G. Pulham, 4, Denholme Road, St. Peter's Park, W. clerk; G. Humphrey Davies, 8, Laurence Pountney Hill, E.C., architect; George W. Sutton, 61, Mostyn Road, Brixton, accountant; Henry M. Carpenter, 37, York Road. N., secretary; and Walter May, 28, Nelgarde Road, Catford, S.E., surveyor. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration as the company may decide. Registered office, 39, King Street, Cheapside, E.C.

Bute Electrical Manufacturing Company, Limited (59,371).—This company was registered on November 2nd, with a capital of £5,000 in £1 shares, to enter into an agreement, dated October 29th, with the "Electric Insulation Syndicate, Limited," and Augustus J. Marquand, and to acquire, own, and work certain existing inventions, particulars of which are not given. The subscribers (with one share each) are:—Hilary B. Marquand, 2, Dock Chambers, Cardiff, shipowner; Thomas MacM. Heywood, 8, Mount Stuart Square, Cardiff, shipbroker; F. Gwilym Treharne, 125, Bute Docks, Cardiff, analyst; Augustus J. Marquand, 2, Dock Chambers, Cardiff, engineer; Edwin Jenkins, Bute Docks, Cardiff, shipowner; George Chitham, 104, Bute Docks, Cardiff, shipowner; and Thomas N. Owen, Cardiff, engineer. The first directors (to number not less than three nor more than four) are Hilary B. Marquand, Thomas M. Heywood, Frederick G. Treharne, and Augustus J. Marquand; remuneration, £200 per annum, divided between them.

Drummond Art Metal Works, Limited (59,372).—This company was registered on November 2nd, with a capital of £5,000 in £1 shares, to enter into an agreement, dated October 31st, with "Whitehouse & Thomas, Limited," and John H. Campbell, its liquidator, and to acquire and carry on the business of electrical engineers, metal workers, gas fitters, &c., carried on by the said company at 17, South Street, Finsbury, E.C., and 189, Drummond Street, Hampstead, N.W. The subscribers (with one share each) are:—C. J. Toy, 35, Westbank, Stamford Hill, N., chartered accountant; J. A. Campbell, 17, South Street, E.C., chartered accountant; Thomas H. Toy, 17, South Street, E.C., merchant; Walter A. Low, 28, Lorne Road, Forest Gate, E., clerk; L. E. Reits, 7, Cotton Street, Poplar, E., typist; Alfred J. Woods, 54, Ansdell Road, Peckham, clerk; and F. C. Collyer, jun., 28, Barry Road, East Dulwich, clerk. Registered without articles of association. Registered office, 17, South Street, Finsbury, E.C.

Hamilton, Motherwell, and Wishaw Light Railways Company, Limited (59,404).—This company was registered on November 3rd, with a capital of £20,000 in £10 shares, to construct, purchase or otherwise acquire any light railways or tramways in Hamilton, Motherwell, and Wishaw, in the county of Lanark, or the neighbourhood thereof, and to work by electricity, or other power, all such light railways or tramways. The subscribers (with one share each) are:—Nauheim J. Ferdinand, 56, Canfield Gardens, N.W., gentleman; Ernest Lazarus, 83, Cannon Street, E.C., chairman British Thomson-Houston, Limited; John T. Mers, The Quarries, Newcastle-on-Tyne, chemical manufacturer; Harold F. Charles, 49, Nunhead Lane, Peckham, S.E., clerk; Alfred Clements, 118, Heath Street, Hampstead, N.W., secretary; W. Martindale, Newlands, Ingatestone, Essex, gentleman; and Albert R. Monks, 83, Cannon Street, E.C., managing director British Thomson-Houston, Limited. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £20; remuneration as the company may decide.

Smith, Simpson & Co., Limited (59,407).—This company was registered on November 3rd with a capital of £2,000 in [£1 shares, to carry on the business of smelters, iron and steel

manufacturers, manufacturers of machinery, boilers, plant, stoves, dynamos, engines, motor cars, rolling stock, &c., and gas, electrical and general engineers. The subscribers with one share each) are:—Walter F. Simpson, Hapton, electrical engineer; Arthur F. Simpson, Manchester Road, Hapton, mill manager; John F. Simpson, Manchester Road, Hapton, grocer; Harold Smith, Netherheys, Colne, Lancs., engineer; Joseph Simpson, 95, Withnell Road, Blackpool, engineer; Arthur G. Brown, 38, Victoria Buildings, Manchester, engineer; and James Hartley, Moorelands, Weaste. The first directors are Joseph F. Simpson (managing director) and Harold Smith; qualification, 100 shares. Registered office, 49, Deansgate, Manchester.

New St. Helens and District Tramways Company, Limited (59,426).—This company was registered on November 4th, with a capital of £150,000 in £5 shares, to acquire the business of the St. Helens and District Tramway Company, Limited (registered in 1889), to construct, maintain, and work any tramways or railways, and to carry on the business of electricians, electrical and mechanical engineers and contractors, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are:—J. A. Willox, M.P., Parkside House, Huyton, near Liverpool, newspaper proprietor; Thomas Evans, 15, Tithebarn Street, Liverpool, cotton merchant; Jacob Atherton, Singleton, Huyton, near Liverpool, manufacturer; D. L. Chalmers, 5, Fenwick Street, Liverpool, chartered accountant; H. Martin, J.P., Olive Mount, Grosvenor Road, St Helens; J. B. Atherton, Manhattan, Gateacre, near Liverpool, manufacturer; and F. J. Leslie, 15, Union Court, Liverpool, solicitor. The number of directors is not to be less than three nor more than seven; the first are Sir John A. Willox, M.P., Thomas Evans, Henry Martin, James B. Atherton, and Jacob Atherton; qualification, £250; remuneration, £250 for the chairman, and £200 each per annum for the others.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Drake & Gorham Electric Power and Traction (Pioneer) Syndicate, Limited (57,352).—This company's statutory return was filed on September 1st, when 1,107 shares were taken up out of a capital of £20,000 in £10 shares; £3 per share has been called, and £3,321 received.

Electric Railway and Tramway Carriage Works, Limited (57,082).—This company's statutory return was filed on September 7th; 16,087 shares have been taken up out of a capital of £150,000 in £5 shares, and £2 per share called; £32,174 has been paid, and £11,079 has been received in advance of calls.

Electric Light and Power Company, Limited (56,786).—This company's statutory return was filed on August 17th, when seven shares were taken up and paid for in full out of a capital of £6,000 in £1 shares (5,000 deferred).

CITY NOTES.

The Western and Brazilian Telegraph Company, Limited.

The report of the directors to be presented at the thirty-sixth ordinary general meeting of the company to be held on November 11th, states that the total earnings amount to £72,692 13s. 10d., as against £59,754 17s. 8d., showing an increase of £12,937 16s. 2d. compared with the half-year to June 30th, 1897. The working expenses amount to £39,376 7s. 9d., as against £44,575 12s. 4d., a decrease of £5,199 4s. 7d. Including the amount brought forward from December 31st, 1897 (£1,428 5s. 11d.), and the dividend received upon the shares held in the "Platino" Company, the balance to the credit of the revenue account is £44,914 2s., from which has been deducted £8,041 12s. 5d. for interest on debentures and debenture stock, £2,016 3s. for income-tax, and £1,078 17s. 8d. has been invested on account of the debenture stock redemption fund, £8,000 has been placed to reserve fund, leaving a balance of £25,777 8s. 11d. The directors now recommend the payment of 5s. per share, free of income-tax, for the half-year on the ordinary shares, being at the rate of £3 6s. 8d. per cent. per annum, as against 3s. per share, or £2 per cent. per annum, for the corresponding period of last year, leaving a balance of £1,427 18s. 11d. to be carried forward. In the case of shares which have been divided into "preferred" and "deferred," the 5s. per share now recommended will be payable, viz., 3s. 9d. per share to the preferred shareholders, and 1s. 3d. to the deferred shareholders. The shareholders of this company having consented to exchange more than the number of shares required under the agreement between this company and the Brazilian Submarine Telegraph Company, the agreement has become operative as from June 30th last. In consequence, directors of the Brazilian Submarine Telegraph Company have become directors of this company, and *vice versâ*, and Mr. Andrews, the chairman of this company, has been elected chairman of the Brazilian Submarine Telegraph Company. Mr. Axworthy has been appointed manager of the company, and Mr. Hodson, formerly the traffic accountant, has been named secretary in place of Mr. Cunningham, who has retired. The arrangement now made will conduce to the more harmonious and efficient working of the companies, and will prove advantageous to the Governments and the public. The dividend warrants will be posted on 11th inst.

Morecambe Electric Light and Power Company.

A general meeting of this company, whose concern has been purchased by the Morecambe Urban District Council, was held at the King's Arms Hotel, Morecambe, on Wednesday, November 2nd, for the purpose of having an account laid before the shareholders as to the manner in which the winding up has been conducted and the property disposed of. Mr. Chas. R. Compston, auctioneer, Lancaster, is the liquidator, and Mr. J. T. Sanderson, of Lancaster, is his solicitor. The balance-sheet submitted by the liquidator showed that the total receipts from February 27th, 1896, were as follows:—

Cash at bankers, being proceeds of the sale of certain plant, £500; plant and material sold, £131 12s. 5d.; acceptances matured, £61 14s. 1d.; Morecambe Urban District Council, gross amount agreed for plant and undertaking, £3,897—from which £1,179 was deducted by arbitration for diminution in value, £2,718; bank interest, £11 19s. 1d.; total, £3,423 5s. 7d. The payments to preferential creditors at the date of the extraordinary general meeting, February 27th, 1896, amounted to £70 18s. 7d.; wages and cost of removing plant and material amounted to £11 1s. 1d.; rent of office and warehouse, £38 2s.; incidental payments, £9 19s. 11d.; Board of Trade fees, £7 2s. 3d.; bank commission, £3 12s. 9d.; solicitors to the Urban District Council taxed costs, £382; Morecambe District Council, half-cost of the award, £41 6s. 9d.; liquidator's solicitor's costs, including witnesses at the arbitration proceedings, £188 10s. 1d.; liquidator's remuneration and out of pocket expenses, £86 15s. 5d.; first debenture bonds in full, including interest, £2,059 11s.; second debenture bonds, including interest, a dividend at the rate of 3s. $4\frac{2}{15}$d. in the £ on £3,098 2s. 8d., makes £523 12s. 3d., leaving a balance of 13s. 6d. There are no assets available for either unsecured creditors or ordinary shareholders, as follows:—Four unsecured cash creditors, £128 11s. 4d.; four unsecured creditors for professional charges, £48 7s. 7d.; one unsecured creditor for rent, £9 10s.; 23 unsecured creditors for plant and trade requisites, £138 4s. 5d.; 104 ordinary shareholders, £6,759; total loss, £7,083 13s. 4d. The accounts were audited by Mr. W. B. Hodgson, the late chairman of the Morecambe Electric Light and Power Company, Limited. The accounts were passed, and it was resolved to destroy the books of the company when the liquidation proceedings have been completed.

Veritys, Limited.—The report of this company for the year states that the accounts show a profit of £20,977 11s. 9d., and and after deducting directors' fees (£2,000), and making due provision for the depreciation of plant, and for bad and doubtful debts, there remains a balance of £16,697 4s. 9d., which, together with £312 9s. 6d. brought forward from last year, makes a total of £17,009 14s. 3d. available for dividends.

New Issue.—The Chelsea Electricity Supply Company, Limited, has this week made a new issue of £40,000 4½ per cent. debenture stock (ranking *pari passu* with £60,000 already issued), at the price of £108 10s. The object of the issue is to provide for the further development of the company's business.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 5th, 1898, were £192 4s. 1d.; aggregate to date, £13,135 12s. 6d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 4th, 1898, were £2,566 19s. 6d.; corresponding period, 1897, £2,545 7s. 5d.; increase, £21 12s. 1d.

The City and South London Railway Company.—The receipts for the week ending November 6th, 1898, were £1,027; week ending November 7th, 1897, £1,041; decrease, £14; total receipts for half-year, 1898, £18,304; corresponding period, 1897, £17,580; increase, £724. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending November 5th, 1898, were £165 6s. 5d.; week ending November 6th, 1897, £108 12s. 10d.; increase, £61 13s. 7d.; total receipts to November 5th, 1898, £7,340 5s. 6d.

The Dublin United Tramways Company.—The receipts for the week ending November 4th, 1898, were as follows:—D. U. T. Co., horse cars, £2,285 15s. 1d.; ditto, electric cars, £334 2s. 4d.; D. S. D. Co., electric cars, £743 6s. 5d.; total, £3,363 3s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 843 18s. 1d.; D. S. D. Co., electric cars, £494 6s.; total, £3,338 4s. 1d.; increase, £24 19s. 9d.; aggregate to date, £75,901 0s. 3d.; aggregate to date last year, £70,102 17s. 4d.; increase to date, £5,798 2s. 11d. Worked:—The mileage open is 13 miles electrically, 31 miles by horses, as against 8 miles electrically, and 34 miles by horses, for the corresponding period last year.

The Hobart Electric Tramways Company.—The receipts for the month of September showed an increase of £108.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 6th, 1898, amounted to £1,451; corresponding week last year, £1,341; increase, £110.

The Mexico Electric Tramways Company.—The receipts for October amounted to £15,600.

The South Staffordshire Tramways Company.—The receipts for the week ending November 4th, 1898, were £662 13s.; week ending November 5th, 1897, £655 2s. 9d.; aggregate receipts for 44 weeks, £27,886 16s. 6d.; last year, £28,181 11s. 8d.

The Western and Brazilian Telegraph Company, Limited.—The receipts for the week ending November 4th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,876.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Nov. 2nd.	Closing Quotation, Nov. 9th.	Business done during week ended Nov. 9th, 1898. Highest.	Lowest
127,400l	African Direct Telegraph, 4 % Debs.	100	4 %	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	6 — 7	5 — 6	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	92 — 95	92 — 95	...	...
905,560l	Anglo-American Telegraph	Stock	£2 9s	£2 13s	3 %	61 — 64	61 — 64	63	61
3,047,220l	Do. do. 6 % Pref.	Stock	£4 18s	£5 6s	6 %	112 —113	112½—113½	113	112¼
3,047,220l	Do. do. Deferred...	Stock	...	...	...	14¼— 14⅜	14¼— 14⅜	14⅜	14
130,000	Brazilian Submarine Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 15¾	15 13/16	15 7/16
75,000l	Do. do. 5 % Debs. 2nd series, 1906 ...	100	5 %	...	...	111 —115	111 —115	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	4 %	2⅜— 3¼	2⅜— 3¼	...	...
10,000,000$	Commercial Cable	$100	7 %	8 %	8 %	180 —190	180 —190	...	...
918,297l	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	2 %	...	1/16— 3/16	1/16— 3/16	...	...
16,000	Cuba Telegraph	10	8 %	8 %	7 %	8½— 9½	8½— 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	15½— 16½	16 — 17	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 11	10 — 11	...	...
30,000l	Do. do. 4½ % Debs., Nos. 1 to 6,000 ...	50	4½ %	4½ %	4½ %	104 —107%	104 —107%	...	...
60,710l	Direct United States Cable	20	2¼ %	2½ %	...	11½— 12	11½— 12	11⅞	11⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101—104	103	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	...	...	...	... ...	172 —177	176½	174
1,295,000	Do. 3½% Pref. Stock	100	...	...	...	104 —107	104 —107	106¼	104¼
500,000	Do. Prov. Certs., 50 % paid	...	...	...	...	52 — 55	52 — 55	...	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	5 %	100 —103	100 —103	...	...
1,432,268l	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	124 —128 xd	124 —128	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	17¼— 17¾	17¼— 17¾	17¾	17⅝
16,200l	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	5 %	100 —104	100 —104	103	...
64,400l	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	103½	...
320,000l	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	125 —129	125 —129	...	...
35,100l	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	...	100 —104	100 —104	...	...
46,500l	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	...	101 —104	101 —104	...	...
300,000l	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	4 %	...	102 —105	102 —105	...	...
200,000l	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	4 %	...	104 —107%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4⅛ %	4⅛ %	4½ %	12 — 12¼xd	12 — 12½	12½	12⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	16½— 17 xd	16½— 17	17	16½
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	10 %	28½— 29½	28½— 29½	...	...
150,000l	Do. do. do. do. 5 % Debs. ...	100	5 %	5 %	5 %	100 —103	100 —103	101	...
97,800	Halifax & Bermuda Cable, 4½ % 1st. Mt. Dbs., w'n. 1-1,200, rd.	100	...	...	...	101 —104	101 —104	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 —55 xd	53 — 56	55½	53½
100,000l	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
484,597	National Telephone, 1 to 484,597	5	5½ %	5½ %	6 %	5⅛— 5⅜	5⅛— 5⅛	5 1/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	13⅛	13
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	...
1,329,471l	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —105	100—103	102½	101
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— ¾xd	⅝— ¾	...	...
100,000l	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	4 %	105 —108	105 —108	...	...
11,839	Reuter's	8	5 %	5 %	5 %	7½— 8½	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	133 —138	133 —138	...	...
58,000	United River Plate Telephone	5	4 %	5 %	6 %	4¼— 4¾	4¼— 4¾	4¼	...
151,733l	Do. do. 5 % Debs.	Stock	5 %	...	...	103 —106	103 —106	...	...
200,000l	West African Telegraph, 5 % Debs.	100	5 %	5 %	5 %	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— ¾	¼— ¾	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	104 —107	104 —107	...	...
64,269	Western and Brazilian Telegraph	15	3 %	2 %	3½ %	12¼— 12⅝	12¼— 12⅝	12⅝	12 5/16
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	8 — 8½	8 — 8½	...	...
33,129	Do. do. do. Def. Ord.	7½	1 %	nil	½ %	4 — 4½	4 — 4½	...	...
389,521	Do. do. do. 4 % Deb. Stock Red. ...	Stock	...	...	...	107 —110	107 —110	...	...
88,321	West India and Panama Telegraph	10	½ %	1 %	¾ %	1⅛— 1⅜	1⅛— 1⅜	1 1/16	1 3/16
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	6 %	9¼— 9⅝	9¼— 9⅝	9⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	6 %	7 — 9	7 — 9	...	...
80,000l	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	5 %	106 —109	106 —109	...	...
158,100l	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	6 %	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	5 %	6 %	7 %	11½— 12½	11 — 12	11 3/16	11½
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	5 %	6 %	8 — 9	8 — 9	8¼	...
60,000	Do. do. do. 4½ % Deb. Stock Red....	Stock	4½ %	4½ %	4½ %	113 —115	113 —115	...	...
50,000	City of London Electric Lighting, Ord. 40,001—90,000 ...	10	5 %	7 %	10 %	23½— 24½	23½— 24½	24½	24
10,000	Do. Ord. Nos. 90,001 to 100,000	10	...	...	...	23 — 24	23 — 24	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	15½— 16½	15½— 16½	15 9/16	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	127 —132	127 — 132	...	...
30,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—30,000	10	nil	nil	nil	12½— 13⅛	12½— 13½	13¼	12⅞
10,000	Do. do. do. Nos. 30,001 to 40,000 £8 paid.	10	...	...	...	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14½— 15½	14½— 15½	15	14 13/16
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	...	5 %	5 — 5½	5 — 5½	...	...
15,661	House-to-House Electric Light Supply, Ord., 101 to 15,761	5	...	...	4 %	9 — 10	9 — 10	9 7/16	9¼
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	7 %	9½— 10½	9½— 10½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	...	6— 6¼	6¼— 6⅜	6½	...
62,400	*Metropolitan Electric Supply, 101 to 62,500	10	4 %	5 %	6 %	15½— 16½	15½— 16½	16	15⅝
220,000l	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	4½ %	117 —121	117 —121	...	...
6,452	Notting Hill Electric Lighting	10	2 %	4 %	6 %	15 — 16	15 — 16	15½	15½
31,980	*St. James's and Pall Mall Electric Light, Ord.	5	7½ %	10½ %	14½ %	16 — 17	16 — 17	16⅝	16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
50,000	Do. do. 4 % Deb. Stock Red. ...	Stock	...	...	4 %	105 —108	105 —108	...	...
65,000	South London Electricity Supply, Ord., £3 paid	5	...	...	...	2⅞— 3⅛	2⅞— 3⅛	2 13/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	7 %	9 %	12 %	14½— 15½	15 — 16	15⅝	15½

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.
§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation Nov. 2nd.	Closing Quotation Nov. 9th.	Business done during week ended Nov. 9th, 1898. Highest.	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	...	...	...	2⅞— 3⅛	2⅞— 3⅛	3 1/16	2 15/16
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	94 —100	94 —100	...	...
30,000	British Electric Traction	10	...	...	...	16⅜— 17⅛	16½— 17⅛	17½	17
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13 — 14	13 — 14	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	2½%	*nil*	*nil*	1⅝— 1⅞	1⅝— 1⅞	1⅞	1 11/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	3 %	*nil*	4 %	2 — 2¼	2 — 2¼	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	112	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	102	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	...	...	...	9½— 10½xd	9½— 10½	9 13/16	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110—113	110 —113	113	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9¾— 10¼	10 — 10⅛	10¼	10 3/16
178,303	Do. do. do. £6 paid	10	...	...	...	5⅞— 6¼	5⅞— 6¼	6⅛	...
61,033	Do. do. Pref. half-shares £1 paid ...	...	...	...	...	1¼— 1⅜	1¼— 1⅜	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	4½— 5	4½— 5	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1 1/16 %	1⅛%	69 — 71	69 — 71	70½	69½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £4 pd.	10	...	...	...	2⅝— 3¼	3½— 4	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	1½— 2	1½— 2	...	...
82,850	Do. 5% 1st Mort. Reg. Debs., 1 to 743 of £100, and 901 to 1,070 of £50 Red.	...	...	...	...	91 — 96	91 — 96	94	92½
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5 %	5⅛%	6 %	2¼— 2¾	2½— 2¾	2¼	2⅛
17,139	Do. do. do. "A" Shares, 01—017,139	5	5 %	5⅛%	6 %	4 — 5	4 — 5	...	...
194,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	101 —103	100 —102	100⅜	...
110,000	Electric Construction, 1 to 110,000	2	5 %	6 %	6 %	2 — 2¼	2⅛— 2⅜	2 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2¾— 3¼	2¾— 3¼	3	2¾
111,100	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	105 —107	105 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅛— ⅛	...	...
67,275	Elmore's Wire Manufacturing, 1 to 69,385, issued at 1 pm.	2	...	...	...	¼— ½	¼— ½	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	7 %	7 %	10 — 12	10 — 12	...	...
12,500	Henley's (W. T.) Telegraph Works, Ord.	10	8 %	10 %	12 %	20½— 21½	20½— 21½	21	20⅝
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 19	18 — 19	18¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	22 — 23	22 — 23	22⅝	22½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅝%	2⅞%	3½%	10⅜— 10½	10 7/16— 10 9/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	15½— 16	15½— 16	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	40	38⅞
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	...	106 —111	106 —111	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10⅛.
British Aluminium, Ordinary, 10—12; 7 % Pref., 11—13.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 105—108. Dividend, 1897, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 14—15.
Yorkshire House-to-House Electricity, £5 Ordinary Shares fully paid, 7⅞—8¼. Dividend for 1896—6%.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (October 13th, 1898).

MARKET QUOTATIONS, Wednesday, November 9th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per ton	37/-	37/-	..
a Ammonia, Muriate (grey) .. per ton	£19	£19	..
a „ „ (white) .. per ton	£26	£26	..
a Bleaching powder .. .. per ton	£6 15	£6 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£14 10s.	£14 10s.	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£18 10s.	£18 10s.	..
a Lead, Nitrate .. .. .. per ton	£23 10s.	£23 10s.	..
a „ White Sugar .. .. per ton	£30 10s.	£30 10s.	..
a „ Peroxide .. .. .. per ton	£27 10s.	£27 10s.	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	65/-	65/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 10	£6 10	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£8 15	£8 15	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3d.	3d.	..

METALS, &c.	This week.	Last week.	Increase or Decrease.
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
c Brass (rolled metal 2" to 12") basis per lb.	6¾d.	6¾d.	¼d. inc.
c „ Tube (brazed) .. .. per lb.	8¼d.	8¼d.	¼d. inc.
c „ Wire, basis .. .. per lb.	7d.	6¾d.	¼d. inc.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£65	£65	..
g „ Wire (basis price) .. per lb.	8d.	7¾d.	¼d. inc.
g „ Sheet .. .. .. per ton	£65	£65	..
g „ Rod .. .. .. per ton	£65	£65	..
h German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	5/6	5/6	..
h India-rubber, Para fine .. .. per lb.	4/- forw'd	4/- forw'rd	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	48/11½	47/7½	1/4 inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	45/-	45/-	..
i „ Wire galvanised No. 8 .. per ton	£9 15	£8 15	..
g Lead, English Ingot .. .. per ton	£13 10	£13 15	5s. dec.
g „ Sheet .. .. per ton	£14 7 6	£14 15	7/6 dec.
l Mica (uncut slabs 6" long) .. per lb.	5/6	5/6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£7 9	£7 4	5s. inc.
o Platinum .. .. per oz.	£2 16	£2 16	..
i Steel, Magnet, according to description .. .. .. per ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£86 to £87	£86	inc.
g „ foil .. .. per lb.	1/4	1/4	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/4	1/4	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	6¾d.	6¾d.	..
j „ Flax, 6 or 8 lea... .. per lb.	3¼d.	3¼d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3¼d.	3¼d.	..
j „ „ Russian, 10 lbs. per lb.	4¼d.	4¼d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£30	£30	..
k Zinc, Sheet (Vielle Montagne bnd.) p. t.	£29 10s.	£28	30s. inc.

a Quotations supplied by Messrs. G. Boor & Co.
b „ „ „ The British Aluminium Co., Ltd
c „ „ „ Messrs. Thos. Bolton & Sons.
d „ „ „
e „ „ „
f „ „ „ The India-Rubber, G.-P., and Teleg. Works Co Ltd
g „ „ „ Messrs. James & Shakspeare.
h „ „ „ „ Jackson & Till.
i Quotations supplied by Messrs. Bolling & Lowe.
j „ „ „ „ Henry C. Yeo & Co.
k „ „ „ „ Morris Ashby, Limited.
l „ „ „ „ Sanders, Wake & Co.
m „ „ „ „ W. T. Glover & Co., Ltd.
n „ „ „ „ P. Ormiston & Sons.
o „ „ „ „ Johnson, Matthey & Co., Ltd.

THE INSTITUTION OF CIVIL ENGINEERS.

Abstract of Presidential Address of William Henry Preece, C.B., F.R.S.*

(*Continued from page* 690.)

Railways.

The regulation of the traffic on a railway, and the general business of the line, could not possibly be conducted without the telegraph. The safety of the passenger and the freedom from collision are due to the introduction of the block system, which is worked entirely by electric signals, and which has been made compulsory by Parliament on all British railways. It was my good fortune to have taken a very active part in the introduction of the block system, especially in the assimilation of the working of the indoor (electric) and the outdoor (mechanical) systems of signalling and in their interlocking. More recently the control of the traffic and the secure working of single lines by the Tablet and electrical train staff has been carried to a very high state of perfection. Distant signals can now be fixed anywhere out of sight of the signalman who works them, for the position of the semaphore by day, or the character of the light by night, are repeated back by electricity upon miniature signals, fixed in the signal box. The state of the signals can even be indicated on the engine to the driver in foggy weather or by night, and the state of distant points shown to the signalman in all seasons.

The employment of electricity in the working of railways has not only been highly beneficent in the security of human life, but it has vastly increased the capacity of a road to carry trains. The underground traffic of the metropolis is conducted with marvellous regularity and security, though the trains are burrowing about in darkness and following each other with such short intervals of time, that the limit of the line for the number of trains has been reached. Electric traction is going to extend this limit by increasing the acceleration at starting and improving the speed of running. It will also reduce the cost of working per train mile, so that the advent of electricity as a moving agency is certain to prove highly economical. What it will do as a remover of bad smells and foul air and for personal comfort cannot be estimated. Time alone will enable us to assess the intrinsic value of public satisfaction acquired by the change.

The extent to which electrical appliances are used is shown by the following Table, which gives the number and description of the various classes or electrical apparatus in use on railways in the United Kingdom in the year 1898:—

Description.	Total.
Single needle	13,494
Morse sounders	431
„ recorders	105
Telephones	12,043
Duplex apparatus (complete)	26
Bell instruments (for message work, complete, with keys, relay and galvanometers, &c.)	425
Phonopores (complete)	110
Block instruments	27,146
Trainstaff instruments	673
Tyer's tablet „	1,137
Interlocking „	4,275
Repeater „	18,450
Treadles	1,658
Fouling bars	452
„ bar indicators	224
Replacers	31
Slot selectors	368
Single-stroke and relay bells	18,447
Galvanometers	390
Large trembler bells (platform, &c.)	2,063
Small „ „	5,913
Night and day switches	4,527
Fire-alarm commutator	96
Train describers	1,122
Light indicators	1,100
Signal repeater discs	924
Test boxes	27
Water-tank apparatus	13
Telephone switchboards	17
Bell indicators	86
Point detector	1
Signal lever lock	230
Extra contact markers and switches	539
Magneto-electric bells	4
Total	115,247

Domestic Appliances.

The introduction of electricity into our houses has added materially to the comfort and luxury of home. The domestic telephone is coming in as an adjunct to the bell. Its use saves two journeys. The bell attracts attention, the telephone transmits the order. Fire and burglar alarms are fixed to our doors and windows; clocks are propelled, regulated and controlled. Even lifts are hoisted for the infirm and aged. Ventilation, and in warmer countries, coolness are assisted by fans. Heating appliances are becoming very general where powerful currents are available. Radiators assist the coal fire by maintaining the temperature of a room uniform throughout its length and breadth. Ovens are heated, water is boiled, flat-irons become and are maintained at a useful temperature, breakfast dishes and tea-cakes are kept hot.

Electric Light.

But it is in supplying us with light, without defiling the air we breathe in our dwellings with noxious vapour, that electricity has proved to be a true benefactor to the human race. The Legislature has facilitated the acquisition by municipalities of those local industries that affect the welfare of the whole community, such as road-making, sewerage, the supply of water, tramways, and, above all, electric light. No one doubts that new industries of a speculative character are best pioneered by private enterprise. The company promoter has, however, so abused the power placed in his hands by the Limited Liability Act that, not only has the development of electric lighting been retarded in this country, but the prospects of private enterprise in furthering other industries has been checked. Fortunately the success, the comfort, the intrinsic value, the economy and the sanitary properties of electric light have commended it to our municipal magnates, and its introduction has become the fashion. The following Table shows the position of the industry in this country and in the United States at the present time:—

Electric Light Undertakings.

	United Kingdom.		United States.	
	Municipalities.	Companies.	Municipalities.	Companies.
Number of central stations	72	63	338	2,251
Capital stock £	4,599,154	3,258,343	3,419,019	48,207,527
Number of arcs	5,753	1,259	26,087	265,064
Number of glows	1,393,514	1,936,893	693,984	14,278,358
Kilowatt capacity	44,219	24,344	41,193	578,051

In spite of our financial troubles, of the inertia of municipal bodies, of the active competition of vested interests, our progress compares not unfavourably with other European countries, but the progress of the industry in the United States has been phenomenal. The return for the United Kingdom is, however, by no means complete. It omits all private installations. We in the Post Office alone have 50,000 lamps which are not enumerated; and if we consider all our great railway companies, banks, warehouses, manufactories, and shops which have their own installations, the statistics will be very considerably extended. Lamps are being improved and cheapened, wiring is being reduced in cost, and the economic distribution of energy is being furthered. But the most promising field for economy is the combination of all classes of electrical industry in one centre, especially that of light and tramway working where fuel is cheap, water abundant for condensing, and nuisances of no account. The cost of the production of electrical energy depends principally upon the continuity of its output. If it can be generated continuously during the 24 hours of the day its cost is only a fraction of 1d. per unit. If it is used solely for light a unit may cost 3d. Hence local authorities, who are undertakers of electric energy, neglect their duty to those who have elected them as the custodians of their interests if they fail to secure the tramways in their district, either as their own property or as customers for their current. For the tramways, by taking energy during the day, reduce the cost of working during the night by removing the incubus of running continuously imposed on undertakers by Act of Parliament. This may enable the ratepayers to be supplied at a price for electric light certainly one penny per unit less than if there were no tramways. The cheaper the supply of energy per unit, the more certain and speedy the advent of the electric light as the poor man's lamp, and the more beneficial its introduction into the confined, ill-ventilated and overcrowded homes of the working classes. By improving the locomotion to the suburbs, and enabling them to live in pure air, and by clearing the air they breathe of the impurities due to the combustion of tallow, oil, and gas, the more readily should the public fall down and worship the golden image which Parliament and science have set up.

It is on board ship that electric light has been pre-eminently successful, and where it filled such a crying want, that its introduction met with no check. It was almost immediately and universally adopted. Search lights, prompted by the great development of the torpedo, were introduced into our Navy as early as 1875 by Mr. Henry Wilde. The first ship to be fitted with internal electric lighting was the *Inflexible*, in 1882. In 1884 the Admiralty ordered it to be applied to all H.M. warships. The first application of electrical power was in the case of H.M.S. *Barfleur*, where motors were used for working guns, and for the supply of ammunition. It has subsequently been partially extended to the working of gun turrets, ventilating fans, capstans, and boat-hoisting gear; but hydraulics, the child of our venerable Past-President, Lord Armstrong, is the form still more generally preferred and used for power in our navy, though other nations make a much more extended use of electricity. The technical reports received by the United States Navy Department indicate that the electrical appliances on their warships worked very successfully during the recent war. Electrical conductors are easily stowed away in safe quarters, and easily repaired when severed by shot. The electrical energy used in a first-class battleship is expended thus:—

* Delivered Tuesday, November 1st, 1898.

Internal lighting	60	E.H.P.
Search lights	65	"
Ventilation	30	"
Capstans, hoists, &c.	60	"
Reserve	45	"
Total	260	"
Number of glow lamps	1,000	
" " search lamps	6	
" " ventilating fans	16	
" " motors	2 to 8	

The following table illustrates the progress of electrical work done by that branch of the service which is so eminently presided over by our vice-president, Sir W. H. White:—

Year.	Ships fitted with electricity.		Total number fitted.		Electric machinery.	
	Search lights.	Internal lighting.	Search lights.	Internal lighting.	No. of sets fitted.	Total E.H.P.
				No. of lamps.		
1876 ..	Nil.	Nil	Nil	Nil	Nil	Nil
1876 to 1880	19	Nil	38	Nil	19	33
1880 " 1884	30	1	50	..	30	120
1884 " 1888	150	30	220	8 000	180	3,700
1888 " 1894	265	126	750	50 000	450	15,000
1894 " 1898	500	240	1,100	95 000	800	25,000

Lighthouses.

The introduction of electricity into our lighthouses has not been such an unqualified success as into our ships. No new electric light has been installed on the coast of Great Britain since St. Catherine's (Isle of Wight) was fitted up in 1888. Other electric lamps are to be found at the South Forland, at the Lizard, and at Soutar Point, only four lighthouses in all upon our coasts.

This is chiefly due to the great prime cost of its installation and to the annual expense of its maintenance. But the sailor himself is not enamoured of it. It does not assist him in judging distances. It is too brilliant in clear weather, while in bad weather it penetrates a fog no further than an ordinary oil lamp. Moreover, great modern improvements have rapidly followed each other in other apparatus, lenses and lamps A third order light of to-day can be made superior to a first order light of ten years ago. Oils have improved and gas has been introduced. Lord Kelvin proposed that lighthouses should signal their individuality to passing ships by flashing their number in a Morse alphabet. But the Morse alphabet, in 1875, was as unknown as Egyptian hieroglyphics to our nautical authorities. The same end was attained with less mental exertion by occulting and group-flashing systems.

A new and very promising plan has recently been introduced in France, called the "Feux-éclairs," or "lightning flash" system. It has been installed in many places, but especially at the two Capes dominating the Bay of Biscay. Nothing more brilliant or more effective is to be seen anywhere than the lights that rapidly sweep across the horizon, like well-directed flashes of summer lightning, with a motion that conveys the idea of a wave of some illuminated spirit-arm warning the navigator away from the rocky dangers of Ushant.

Our Trinity House has not yet introduced this plan. Any change of our well-considered and deeply-important coast-lighting system is not to be hastily effected. We are very proud of our well-guarded shores. Every headland and landfall, every isolated rock, all dangerous shoals and banks and narrow channels in lines of trade are so illuminated that navigation by night is as safe and easy as by day. Lighthouses and lightships stud our channels. Most of them are placed in direct communication with our Post Office telegraph system, so that the speediest help can be secured in moments of difficulty and danger.

We, however, want improvement in fogs and storms. Here electricity steps in. I wrote, in 1893, of wireless telegraphy:—"These waves are transmitted by the ether; they are independent of day or night, of fog or snow or rain, and, therefore, if by any means a lighthouse can flash its indicating signals by electro-magnetic disturbances through space, ships could find out their position in spite of darkness and of weather. Fog would lose one of its terrors, and electricity become a great life-saving agency." We are nearing that goal.

Traction.

Electrically-worked railways originated in Europe. The first experimental line was constructed by Dr. Werner Siemens in Berlin, in 1879. When I visited America in 1884, there was only one experimental line at work in Cleveland, Ohio. Now there are more miles of line so worked in Cleveland alone than in the whole of the United Kingdom. The reason for this is not difficult to comprehend. The climatic influences of the States, the habits of the people, the cost of horseflesh, the necessity for more rapid transit, soon proved the vast superiority of electric over every other form of traction. Horses and cables will soon disappear. In England the Tramways Act of 1870 has been restrictive. It deferred the real solution of the question for 21 years. Its avowed tendency has been to throw the industry into the hands of the municipalities. Private enterprise has therefore not been encouraged, and municipalities have not taken it up. Local authorities have now been educated. The successful progress in the States and on the Continent has proved contagious, and everywhere our great cities are rising to the occasion. Indeed, to neglect to supply tramways where they would be useful, healthful, and valuable, is to a certain extent an abuse of the trust confided to the municipality by the Legislature. Rapid and convenient suburban transit is a social factor of great importance to the working classes, who can be readily transported from close quarters to pure air and healthy dwellings. Hamburg is one of the best trammed cities on the Continent. The trams were constructed by private enterprise under lease from the municipality. The latter supplies the electric energy. The tramway company is bound to take the current at a fair and reasonable price, but they have also to pay a tax on the gross receipts, which is set aside by the local authority as a sinking fund, so that on the expiry of the agreement the town will have the capital to purchase the tramways. Corporations in this country who have secured a provisional order for the installation of electric light have secured also legal powers to supply electric energy for all purposes. It is therefore their right, and it may become a very valuable property. The duplication and multiplication of central electrical stations is likely to become a serious evil. It is absurd to see two buildings erected where only one is needed, and two causes of nuisance perpetuated where none need exist. I have already pointed out the economy of combining electric lighting and tramway working. The relative merits of overhead and underground conductors, and the use of storage batteries, are practically the only important engineering questions under discussion. The underground conduit system has been materially helped by the practical object lesson to be seen in New York, where the tramways are being very successfully worked on this plan. The trolley system is much more economical. Its erection does not interfere with the traffic of the streets. The principal objection to it is its anti-æsthetic appearance, but it is wonderful how ideas of utility and the influence of custom make us submit to disfigurement. What is more inartistic than a lamp-post, or more hideous than the barn-like appearance of many a railway terminus?

The corrosion of water and gas pipes, the disturbances of telegraphs and magnetic observations, are serious questions arising from the introduction of powerful currents into the earth, but fortunately the remedies are simple, easily attainable, and very effective.

I have alluded to the proposed working of our underground railways. The success of the Mersey Dock line, and of the South London and Waterloo lines, have placed the question beyond controversy. The problem to be solved is, how is the conversion from steam to electricity to be effected without interfering in any way with the existing traffic or with the existing permanent way? This is not to be solved on paper. It must be determined by actual trial, and this is about to be done on the short line connecting Earl's Court and High Street, Kensington. Electric traction as an economical measure in all cases of dense traffic is so certain, that every great railway company must consider, sooner or later, the working of their suburban traffic by electricity. This experiment on the Metropolitan Underground Railways, therefore, should interest them all. It is a question deeply affecting the interests and comfort of the public and the condition of the congested traffic of our streets.

The storage battery fulfils a very important function in the economical working of an electric railway. It equalises the pressure on the circuit. It meets the fluctuations of the load. It takes in current when the load is light; it lets out current when the load is heavy. It thus secures the continuous working of the engines at their full constant and most economical conditions, and it enables the engines to be shut down altogether when the load is very light as it is at night, in the early morning, and on Sundays.

In Buffalo the battery is charged by energy from Niagara, 21 miles away, and the local engines are shut down for 12 hours every day and for 10 hours on Sunday.

Electric traction is invading even our streets. The number of unstable and weak-kneed cab horses seem destined to be reduced by their electric competitor; while the pride of London—the fleet hansom—will be freed from an obstructive and not always sweet-smelling *avant courier*. When the real storage battery is produced the automobile problem will be solved. At present steam and oil are active competitors.

(To be continued.)

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

Mr. Raworth's Presidential Address.

Mr Raworth said that the position he had taken up was one of considerable difficulty; he had entered upon a task which in its initiation seemed extremely easy, but which in its fulfilment he had found difficult. The subject which he intended to bring before them that evening had a very wide scope; it was intended to cover the whole range of electrical practice and experience, and that fact alone would show them that he must necessarily to a very large extent fail, because no man had an experience of that width. He had therefore endeavoured, so far as he could, to make, as it were, a skeleton upon which they would, he hoped, hang the fruits of their experience, and make that inaugural address worthy of his intention. The Northern Society, measured by its numbers, was small and insignificant, but measured by its activity, by the energy and enterprise of its members, it was, he believed, the first electrical society in the kingdom, and it was because the members had been so very full of work during the present

year that the Council had found it extremely difficult to get the members to prepare and to promise papers for this session; in fact, so great was the difficulty, that although they were able by the assistance of members of Council to fill up succeeding dates, it was found quite impossible to carry out the intention of the Council that the first paper of the Society should be read in October. It was simply because they made up their minds that they would carry out the intentions of the Council that they held that meeting at all; it was not because he had a malevolent desire to inflict upon them a second address. Knowing full well that all their instincts were scientific, and that the only way to excite their interest was to bring before them some new scientific development, or the prospect of such development, he found that evening that he had got a subject which was not in any sense scientific, but he thought they would not find it altogether uninteresting, nor the time vainly spent, if they were to devote half an hour to the consideration of their prospects in life. On January 10th, 1898, he addressed them on the prophetic aspect of the same question. He then told them that he had in his mind's eye an enormous development of electrical engineering in the year 1898. It appeared to him at that time that every one of the fields of their energy and enterprise was at a point when it was likely to move forward. We had arrived at that point at which at any moment any one of those fields might absorb the whole of their manufacturing power, and he endeavoured to show that although Continental countries were making great strides in the water power production of electrical energy for transmission, there was no need to be anxious, because with cheap coal so close, they at home were in a position to manufacture electrical energy almost, if not quite, so cheaply as they were able to do in Continental countries by water, except, perhaps, in those places where the water power could be developed at an abnormally low cost. The *Engineer* said that as far as they could see, electricians were always promising to do something wonderful, but never did, that electricity was a very expensive luxury, and that the time was far distant when we should be able to produce electricity at anything like the figures that we quoted. He thought that they would approve of his conduct in not replying to that criticism, for they all knew that the opinion of the *Engineer* on electrical subjects was usually, if not always, wrong. In process of time, however, Mr. Hammond wrote his paper on the cost of generation and distribution of electrical energy. He showed clearly to the *Engineer* that the cost of electrical energy had been going down during the past few years in a most marvellous manner, and it had actually descended to one-third of what it was, and that the *Engineer* in quoting figures against him knew nothing whatever of the subject.

In proceeding with his subject, he first of all proposed to run lightly over the departments on which the development had been more or less strongly marked. In the second place, he proposed to glance at the principal influences which affected the rate of progress. That he thought was the most important matter that they had to consider.

The first thing that naturally arose in the mind was the department of electric lighting. He was not going to trouble them with many figures, but he had to give them a few, because they were so interesting that he did not think they would like to go away without knowing them. In the year 1896 the subscribed capital for companies was £5,800,000, and for municipalities just under £2,000,000. In 1897 the companies went to £6,600,000, and municipalities £3,500,000. In 1898, companies jumped up by nearly £2,000,000, and municipalities by a rather larger amount, *i.e.*, to £5,735,000, so that at the present moment the total amount of capital involved in electrical lighting was £14,142,000. A most important point was, that in the years 1882-3, which were known as the years of the electrical "boom," the total amount of capital subscribed was £14,743,000. If they had only taken care of the money which the public subscribed in those two years, we should never have had to ask for a single penny more in the whole of the 15 years which had since elapsed. Coming to the present year, they found that the activity in electric lighting was very pronounced. There were in 1896, 38 applications for provisional orders; in 1897, 55; in 1898, 84; the total orders in force being 343, 100 held by companies, and 243 by municipalities. There were works in operation owned by 57 companies and 75 local authorities, and 66 works were in course of preparation. He wished to draw attention to the important fact that 145 provisional orders had been granted, concerning which nothing whatever had been done. There was no doubt that in most of those cases the ground was ready for the ploughshare. There was a point of interest which he had noticed in analysing the figures; he found that out of every £100 applied for the purposes of electric lighting, £37 went to the manufacturer of plant, and £34 per cent. to the manufacturer of mains. Manufacturers of plant made all the noise, and held all the meetings, and as far as he could see the manufacturers of cable made the profit. In 1897 the total number of units sold was 60,125,000, and a curious point about that was that the whole of that current could have been produced by no more than 20 1,000-kilowatt sets working during factory hours. But the actual amount of plant employed was not less than 72,000 kilowatts. The human mind always found a difficulty in dealing with small or large figures. The moment they got into millions, it seemed as though the mind could not quite grasp what was talked about. They might think that because we had 14 millions in the electrical industry that we had pretty well absorbed all the capacity of the English shareholder. But compare electricity with gas; the total capital employed in gas was 76 millions, and they spent as much every year upon making their gas as the total subscribed capital of the electrical industry, *i.e.*, 14½ millions.

The next point to consider was that of electric propulsion. As he had told them last Christmas, they had in all about 133 miles of tramway working. Owing to Parliamentary preliminaries to be gone through, plans to be got out, and capital to be subscribed, there had been very slow progress. They had only added a matter of about 40 miles to the total of last Christmas. There were under construction at the present moment 39 miles by municipalities and 45 miles by companies.

In the session of 1898, five electric railway bills were passed, 17 tramway bills for local authorities and 10 for companies, and 11 provisional orders, in addition to which light railway bills had been granted for 140 miles of line. That, he thought, looked fairly healthy, but the most remarkable fact was that the impression made upon their minds by this business was not anything like so startling as that which they could receive on looking down those four pages of *Lightning*, containing the results of electric supply undertakings, but when they came to actual figures, they found that the amount of subscribed capital was £14,400,000, being about £270,000 more than the subscribed capital for electric lighting. How did that come about? Where was the money going to, and where had it gone? He thought it was very difficult to answer the question; it was partly owing to the initiatory expenditure on schemes, and partly owing to the large and expensive undertakings which were being carried out in London to connect the suburbs with the City by means of underground tunnels. Every mile absorbed nearly half a million pounds, so that the amount of capital subscribed for that alone had gone very far to produce the figure of £14,400,000. The unfortunate part about it was that the money did not go into their pockets, or at least only a very small percentage of the money subscribed for underground railways ever reached the pockets of electrical engineers. It went to the engineers of Westminster, or to the contractors for underground work. There were one or two other developments in propulsion which he had to speak about, but which were not quite so hopeful from their point of view as those which he had already mentioned. The first was the propulsion of boats, and as far as he knew the only active company was the Immisch Company, on the Thames, and which owned a large number of launches, having a capital of £10,500, and which paid a small dividend; he himself was one of the directors. He was looking forward to that class of propulsion developing somewhat in the future. Electric launches were tried on Lake Windermere, and they were probably aware of the fact that the undertaking was a comparative failure. He wanted to disabuse their minds that that failure was due to the shortcomings of the electrical portion. It was entirely due to the human element. The undertaking had been badly planned, so that the boats had to go several miles to be charged, and several miles back again to their work. The consequence was that the actual available net charge was below the paying limit. The next point which he would bring before their notice was the electric cab. He wished he could tell them that the electric cabs were going to be a great success. Their number had been very greatly increased, and he understood they worked very well, and so far as passengers themselves were concerned he believed they gave every satisfaction. How the accumulators were working he could not tell.

The next head was the electrical distribution of power. The present year had been a very important year to them from the point of view that a Lords' and Commons' Committee had been appointed to sit upon the general question of electrical distribution of power. First of all they passed two Bills; the "Chelsea" to enable the company to purchase compulsorily a site within their own area; that was an enormous step in advance of anything that had been previously done. The next one was the Metropolitan Company's Bill to enable them to lay mains outside their area, and to bring current in. There was a still further and a more drastic clause. It enabled a company supplying a given area to put its generating station right outside that area, and to get wayleaves across the territory of adjoining authorities for its mains to enter its own area. Then the Joint Committee passed its opinion as follows upon the general principle of the distribution of power. First, that powers should be granted for the supply of electrical energy over an area including districts of numerous local authorities on conditions differing from those imposed by the existing Acts. "Differing" meant better. Secondly, they expressed the view that the provisions of the Electric Lighting Acts for the purchase by local authorities were inapplicable in the case of an undertaking supplying energy in bulk at a high voltage. Those expressions would prove most valuable in the coming session of Parliament. The Bills now before the House were that of the General Power Distributing Company, which they knew was going to take a large area in the neighbourhood between Nottingham to Sheffield, an area of about 2,000 square miles; and the Bill of the Midland Electric Company for Power Distribution, whose area was in the Black Country, and who had a capital of £200,000 on paper. Those two were magnificent schemes. Whether they were well thought out and going to pay he was not prepared to say, but they owed a debt of gratitude to them because they squeezed out of the Lords' Committee those two very important concessions. They had, moreover, in their midst as it were, a scheme which he thought would commend itself not only to them, but to all electricians and engineers throughout the country, as being perhaps the most practical development of this idea that has yet come out. He referred to the Trafford Park Estate scheme. That was an undertaking that had been favoured by Messrs. W. T. Glover and Co., who were promoting it, and so far finding the money for it. The object was to supply power in bulk for driving all the factories, lighting the factories, and for supplying producer gas to the houses on the Trafford Park estate. That was a perfectly feasible scheme, on which every engineer could form an opinion from the commencement, and it would be the nucleus of a much larger development. The engineers had told him that they originally looked upon his figures of the price at which electrical energy could be produced and sold with considerable doubt. They worked out those figures upon their own lines, and found that the results of his calculations and theirs came out sufficiently close for all

practical purposes. There was at the same time that scheme called the Highland Power Scheme of Scotland, of which, however, he could give them no further information. As to the general distribution of power in factories, that was making very satisfactory progress. He had a note respecting the electrical chemical industry; that was one of those things which he did not understand, but he believed it was making very good progress. It must be patent to everyone of them that the Castner-Kellner process of making alkali by electrical energy had proved so far a success. He hoped that the success would be permanent, so that there would be a prospect of such business opening up to them. One other point came to his notice, and that was the new process of reducing ore by powdering aluminium, making it up with ore, and igniting the mass electrically, when chemical energy would be immediately let loose and propagated through the whole mass, the heat generated being nearly equivalent to that of the electric arc. The immediate effect was the reduction of the metal operated upon. If that invention proved a commercial success, it would open an enormous field for the use of aluminium, and consequently for the use of electric current.

He ought now to consider what were the causes which were working towards the extension of the use of electric current. They knew perfectly well whenever an electric lighting station was put down, and worked well or badly, its consumers increased, the revenue increased, and the profit increased, and the most natural thing which he could do was to give them a few figures to show what that development amounted to. He had taken as illustrations four stations which had suffered very little from alterations in price, viz., City of London, Newcastle, Kensington, and Chelsea, and he found that with those, with the exception of the year, 1894-5, when the increase in the City of London was 48 per cent., the increase from year to year had been about 25 per cent. The year 1895-6 was a phenomenal year. The City of London increased 43 per cent. and Chelsea 41 per cent., but both of these places were subject to peculiar circumstances. However, they might take it, he thought, that the natural increase was somewhere about 25 per cent. The next point was one of much more importance to them. That was the question of how far the cost of plant and the cost of working affected their business. A few years ago (about five or six), the cost of a 100-kilowatt plant rope driven was £1,600 to the public. Now the price for a direct driven plant was from £1,300 to £1,400, but in the meantime either our faith or ideas had grown so much, that no longer did we talk about 100-kilowatt sets. Last year all the inquiries were for 300-kilowatts; this year they were for 600-kilowatts, and he understood Manchester had gone to 2,500 H.P. A 600-kilowatt plant was worth about £6,000, and six plants of 100-kilowatts each would cost £9,600, so that there was a saving of £3,600. If they had put on to the top of that the saving in switchboards, land, foundations and buildings, the cost of plant should not be more than about 60 per cent. of what it was five or six years ago. He thought to a very large extent their efforts had been stimulated to take those big leaps by the clear understanding that those enormous wastes which were supposed to accrue from running engines at half-load, could be obviated by a good vacuum and automatic expansion. With reference to the working of stations, they knew more about that than he did. It was worth while putting upon record the fact that whereas four or five years ago they did not think it at all an extravagant thing to spend 5d. a unit, now there were 14 stations whose total costs, not meaning the absolute cost of the unit, were under 2d. That was very interesting, and a very important fact for them. In Edinburgh the cost was just under 1½d., and in Manchester it was about 1½d. As the cost came down the demand increased. The moment they could sell to the ordinary consumer at a price which was obviously to him less than the price of gas, they would sweep in the whole number of possible consumers.

The next point was Parliamentary procedure, which at present was both tedious and costly. There was not a great prospect of their getting much amelioration in that line, but they might get some, and the recommendations of the Lords' and Commons' Committee, and the provisions of the Light Railways Acts were distinctly favourable to the progress of the electrical industry. They would notice he had put down on his list of principal influences which affect progress an item marked D under the heading of the "Avarice of Municipalities;" he had limited it to this narrow word "avarice" because he did not want to go into the discussion of the question as to whether, from political reasons, it was an advantageous thing for municipalities to take over and manage their business. Neither did he wish to suggest that Town Councils were more avaricious than other people. He took it that they were all about the same. They all wanted to get what they could, but there was a great difference in the way in which avarice was exercised. For instance, in some men it produced industry, prudence, and thrift, whilst in others it produced nothing better than envy and covetousness.

He believed that the municipalisation of commercial enterprises would be settled by proof or disproof of its economic advantages. He considered that municipal electric lighting was too young to provide a good basis of comparison; the results were contradictory and at present too much under the influence of the personalty of the engineer to permit of accurate conclusions being drawn from them, but municipal gas lighting was quite old enough for the purpose, and the results would be compared by reference to two large volumes, which were the Board of Trade returns of the gas undertakings in the United Kingdom, one representing companies and the other municipalities. There are 208 municipalities and 433 companies owning gasworks.

First consider Manchester, a City which manages its gasworks nearly as well as they can be managed by a Corporation. The price is 2s. 3d. per thousand and the profit is £33,153 interest and £40,000 in aid of the rates, total £73,153. On the other hand, the South Metropolitan Gas Company charges its consumers the same price and makes four times the profit or double the output, that is, twice the profit *pro rata*, notwithstanding that it has to pay heavy carriage on coal. Again compare Manchester with the Sheffield United Gas Light Company, the two cities being nearly on a par as to cost of coal. The price of gas at Sheffield is from 1s. 8d. to 2s.; the consumption is about one-half that of Manchester, and the profit is £78,829, that is more than double *pro rata*. If the Sheffield Corporation were to authorise the company to charge the Manchester price of 2s. 3d., they could afford to pay over £42,000 in aid of the rates at the expense of the consumer; or, if their output were as large as that of Manchester, they could pay over £80,000 a year in aid of the rates and still pay to their shareholders £140,000 per annum, as against the £33,153 paid for interest in Manchester. But, assuming for the moment that the results in Manchester were as perfect as in Sheffield, the amount handed over in aid of rates would be not £40,000 but £80,000 + (£140,000 − £33,153) = £186,847. Permit me to ask, where does the Manchester ratepayer come in? Has he got the "substance" of cheap gas, or the "shadow" of 10 per cent., or has he got neither? The same argument applies to the City of Birmingham, except that with equally cheap coal their price is from 2s. 3d. to 2s. 7d., with 5 per cent. discount, and yet they desire to manage their electric lighting.

Now take two towns as dissimilarly placed as possible—Wigan and Plymouth. Wigan is built on gas coal—Plymouth is hundreds of miles from it. Wigan Corporation charges 3s. 1d. Plymouth charges 1s. 9d., but in this instance Wigan pays in aid of rates £9,697, but the difference between their price and that of Plymouth on their output amounts to £6,600, so it is clear that considering the relative prices of coal they are taking the whole of their apparent profit out of the pockets of their gas consumers, that is to say, of their ratepayers. Again, compare two gas undertakings placed side by side and subject as nearly as possible to identical conditions—Stoke-on-Trent Corporation and the British Gas Light Company (Potteries). The Corporation price varies from 3s. 6d. to 2s. 9d., but the company's price is only 2s. 3d.

Electric traction and electric distribution of power was being pushed on by private enterprise, and he hoped that this active private energy would not be entirely killed by municipal obstruction. There was one point which was always before them, and that was foreign competition. He was not afraid of it; in fact, it appeared to him, that at the present moment, it was a good thing that it was possible to get plant from America, because, had it not been for that fact, electrical enterprise in the year 1898 would have been suffering from great strangulation. The Central London Railway Company had ordered, he believed, seven sets of 1,400-H.P., the Metropolitan, three of 2,500, and the County of London, two sets of 1,000, all manufactured in the States and sent over here, but he knew, with regard to some of them, that if they could have been made in this country in the time, the order would not have been sent to the States. It came down to this fact, that the Americans were not competing with us at our prices, they were only supplying those orders which could not be done in this country. The last item in the synopsis, as it was getting very late, he would skip altogether; they knew perfectly well what it meant.

FRENCH NAVAL ELECTRICIANS.

Circular from the Minister of the Admiralty, dated October 1st, 1898, relating to the tests to be put before the working electricians to be appointed to the vessels of the fleet:—

The Minister of the Admiralty, to the Vice-Admirals, the Commander-in-Chief, and the Maritime Prefects.

Gentlemen,—In accordance with my circular of September 13th last, relating to the recruiting of electricians to be admitted into the vessels of the fleet as voluntary servants for three years, I have the honour to inform you that I have drawn up the following conditions for the practical and theoretical examinations that they will be required to pass:—

1. *The Composition of the Committee.*—(*a*) *In the Ports.* The captain of a frigate; a lieutenant (torpedo-boat); a chief mechanic of the 1st class (torpedo-boat if possible).

(*b*) *In Paris.* The chief of the bureau of the central torpedo and electrical service; a lieutenant attached to this service; a naval engineer attached to this service.

2. *Examinations.*—The examinations will take place during the first ten days of each month at a date that shall be fixed by the Maritime Prefect.

(*a*) *Practical Examinations.*—The manual tests to which the electrical candidates will be subjected will include three operations selected respectively from each of the three groups A, B, C given below.

A. (1) To make a junction with conductors of several wires. (2) To splice one conductor on to another. (3) To make a brush. (4) To cut a brush. (5) To restore a brush, the wires of which are bent back.

B. (1) To make a commutator. (2) To make an interrupter. (3) To make a circuit breaker. (4) To make a junction terminal. (5) Given an incandescence lamp, to make a suitable socket for it.

C. (1) To disconnect and connect a Leclanché battery element. (2) To disconnect and connect an electric bell. (3) To introduce

into a given circuit a bell or a galvanometer. (4) Given a battery, a bell, and an interrupter, to instal them in circuit.

(*b*) *Theoretical Examinations.*—The candidates will be examined in the following subjects:—

D. The composition and nomenclature of a complete circuit; battery element for bells and test batteries; dynamo (boat type); distribution board; amperemeter; voltmeter; commutators; interrupters; circuit breakers; incandescence lamps; fixing sockets; arc lamps; search lights; accumulator elements; battery of accumulators.

E. Batteries: To charge and connect up a battery; to introduce a bell battery into a circuit.

Dynamos: Preparations for starting; insulation tests; tightening the brushes; surveillance during working; indications of the instruments; lubricating; signs of bad working, heating, sparks, abnormal indications of the board; precautions to be taken during manipulations; maintenance of apparatus when at rest; inspection of contacts throughout the circuit.

Accumulators: Connecting, filling, closing, charging, and discharging; conditions of normal working; general care and precautions.

A ticket will be given for each of the professional tests included in the groups A, B, C, and for each section D, E, of the theoretical examination.

These tickets will be supplemented by the following additional ones:—

One for each of the manual tests; two for each ticket of the theoretical examination forming a total of seven.

Certificates of eligibility will be issued according to the conditions laid down in Articles 44 and 47 of the decree of June 5th, 1897, relating to the present service; but no candidate can be admitted unless he obtains a minimum of 98 marks corresponding to a mean of 14.

The candidates showing proofs of the required aptitude will be admitted into the vessels of the fleet as working electricians of the 1st, 2nd, or 3rd class according to the certificate of eligibility granted to them, and will receive the pay allowed in the class to which they belong.

I beg that you will give the necessary orders of detail for the execution of this dispatch.—E. Lockroy. (*L'Industrie Electrique.*)

POWER GAS FOR TRAMWAYS.

Steadily, if somewhat slowly, the idea of gas power advances and takes deeper hold; *Le Genie Civil* contains an account of the electric tramways at Lausanne, which are notable as being dependent for their motive power upon a gas plant.

Coal is so dear a fuel in Switzerland, that the country's large store of water-powers has been much drawn upon for power purposes, and the use of electricity has become quite common. In England we have no water-power, and such cheap gas that much of the impetus present in other countries is absent. At Lausanne, presumably water-power was not available, at least for the particular purposes of the tramways, and the choice lay between steam and gas, and was solved in favour of producer gas, though several steam engine builders offered to guarantee a steam expenditure of not over 22 lbs. per effective H.P.-hour, or 2·48 lbs. of coal with an evaporation factor of 8. Gas power plant builders, however, offered power for 1·137 lbs. of coal per H.P.-hour, and the plant has worked two years. It includes three Crossley engines of 130-H.P. each, and three revolving bottom Taylor generators worked by superheated steam blast and air, the result being a mixture of part water gas and part power gas of higher calorific power than ordinary producer gas. It is cooled, scrubbed, and purified, and passes to the engines *vid* a holder. The clinker is removed by revolving the generator bottom once a day. The engines have each two opposed cylinders on one crank, and this gives steadiness with a 6-ton fly-wheel. The jacket water is circulated and sprayed and used over and over again. It seems strange so near Lake Geneva to find water scarce.

The generators are of the Thury type, feeding a 300-element battery of 700 ampere-hours capacity. This serves to equalise the load. The line is eight miles in length and less than one mile is on a level. The maximum grade is 11·3 per cent., and is operated by adhesion alone. The cars seat 32 passengers and have each two Thury motors of 20 H.P. The overhead system is employed, and cars have an independent electric brake as well as a hand brake.

During the first half of 1898 the fuel consumption was 850,000 lbs., the output 413,849, or equal to 2·05 lbs. of fuel per kilowatt. The fuel includes all fuel burned, even that for finding distilled water for accumulators. With steam engines the fuel expenditure per kw. would be 3·78 lbs., so that by the use of gas there has been effected an economy of £800 annually. This installation is but another proof of the economy to be derived from the use of producer gas. Undoubtedly the gas engine has been helped by the fact that illuminating gas has been so ubiquitous, but at the same time, it has also been retarded by the great comparative unit cost of such gas, and the ideal gas has not been understood. Producer gas need not necessarily require a steam boiler to work its plant as at Lausanne. Equally good results are obtainable with gas plant operated by fan blast, any water being added from the wet bottom or hearth or by spray into the blast pipe. The object in view when a manufacturer or mill owner puts down gas plant is not to have gas plant plus a steam boiler but gas plant simply, which shall enable him to abolish the boiler altogether. Where this has been done we know that the question of fuel expense has lost much of its previous seriousness to the power user.

THE LARGEST DYNAMO IN THE WORLD.

In the issue of *L'Energie Electrique* for October 1st, 1898, is given a description of a dynamo which is being made by the Walker Company at Cleveland for the Boston Elevated Railway Company. This dynamo is to develop 3,000 kilowatts at a speed of 75 revolutions per minute.

The framework is of cast-steel; its form is circular, having a diameter of 6·604 metres. The weight of the framework alone is 22,675 kilogrammes. To the interior of this framework are bolted 24 pole pieces, whose aggregate weight is 13,605 kilogrammes. The distance between diametrically opposite poles is 4·724 metres. The pole pieces are furnished with bobbins wound in shunt and series as usual.

The framework of the field magnets is in two parts, the plane of separation being horizontal. It is fixed on the base plate in such a way as to be capable of motion parallel to the shaft of the machine to a sufficient distance to allow of the removal of the pole pieces without separating the two parts of the frame. The armature shaft has a diameter of 0·94 metre, and the armature will be built in position at Boston. The armature core will have 594 grooves in which the windings are to be placed. The commutator is composed of 1,188 copper bars; its diameter is 2·667 metres. The enormous fly-wheel will be bolted directly to the armature near its periphery in such a way that the regulating power of the fly-wheel will not be transmitted through the shaft. This arrangement will relieve the shaft of the armature and the keys from the enormous strains that they would otherwise have to bear. The whole weight of the complete dynamo is 113,375 kilogrammes.

The machine has been designed with the greatest care. Each part subjected to mechanical or electrical strains possesses a high factor of safety. The dynamo is capable of developing twice its normal output for a short time, and can stand continuously an overload of 50 per cent.

The greatest care has been taken to render the efficiency of this machine superior to that of existing large dynamos.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

6,991A. "Improvements in index needles or pointers for electrical and other indicating or measuring instruments." E. Weston. Dated October 28th. (Date claimed under Patents Rule 19, March 22nd, 1898.) (*Complete.*)

22,315. "A method of and improvements in apparatus for electrically indicating time." C. E. Kelway. Dated October 24th.

22,334. "Combined engine and dynamo which may also be used as a motor and pump or compressor." B. J. B. Mills. (C. C. Cowan and M. L. Whitfield, United States.) Dated October 24th. (*Complete.*)

22,335. "Improvements in connection with branch lines from strong currents for preserving the insulation." C. Smith. (L. Gottscho, Germany.) Dated October 24th.

22,344. "Improvements in electric arc lamps." H. Delavan and F. F. Berbat. Dated October 24th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 24th, 1898, being date of application in France.) (*Complete.*)

22,357. "Railroad switch." C. H. Strauss and B. J. Rosten. Dated October 24th. (*Complete.*)

22,383. "Improvements in closed conduit electric traction." R. Kennedy. Dated October 25th.

22,396. "An electrical fish-pond (improved)." J. F. Morris. Dated October 25th.

22,419. "Improvements in telephone transmitters." M. Byng. Dated October 25th. (*Complete.*)

22,434. "A new or improved device for regulating the tension of continuous electric currents." D. Monnier. Dated October 25th. (*Complete.*)

22,442. "Improvements in electric discharging apparatus for use in the manufacture of waterproof cloth." C. J. Beaver and J. E. Baxter. Dated October 25th.

22,449. "Improved combined brake-pipe and electrical coupling for railway trains." A. G. Wild. Dated October 25th.

22,461. "Improvements in primary batteries." J. Y. Johnson. (H. J. Dercum, United States.) Dated October 25th. (*Complete.*)

22,486. "Improved means of electric communication between the passengers, guard, and driver of railway trains." T. Wilson. Dated October 26th.

22,523. "Improvements in conduits for electric tramways." M. H. Smith. Dated October 26th.

22,537. "Improvements in or connected with electric push buttons." G. Markt. Dated October 26th.

22,545. "Improvements in automatic telephone exchanges." W. P. Thompson. (The Strowger Automatic Telephone Exchange, United States.) Dated October 26th. (*Complete*).

22,547. "Improvements in appliances or apparatus for automatically replacing fuses in electric light and power installations." S. Harrison. Dated October 26th.

22,569. "Improved 'self-replacing' indicator for bells, telephones, or other apparatus." E. N. W. Hume. Dated October 27th.

22,578. "A new or improved method of bonding or connecting rails used for electrical traction and the like." W. Rushton and R. E. Griffin. Dated October 27th.

22,584. "An improved telephone index." J. F. O'Brien. Dated October 27th.

22,599. "Improvements in electric meters." The British Thomson-Houston Company, Limited. (C. D. Haskins, United States.) Dated October 27th. (*Complete.*)

22,600. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (G. B. Painter, United States.) Dated October 27th. (*Complete.*)

22,601. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (H. C. Spinney, United States.) Dated October 27th. (*Complete.*)

22,603. "Improvements in prepayment electricity meters." F. M. Long and E. Schattner. Dated October 27th.

22,622. "Improvements in or relating to electrolytic baths." Q. Marino. Dated October 27th.

22,664. "New or improved appliances for use in securing the copper bonds or conductors in electric tramway rails." W. M. Munro, H. Brecknell and H. I. Rogers. Dated October 28th. (*Complete.*)

22,683. "Improvements in couplings for electric conductors." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 28th. (*Complete.*)

22,686. "Improvements in magnetic brakes." S. Pitt. (The Elektricitäts Aktiengesellschaft vormals Schuckert & Co., Germany.) Dated October 28th. (*Complete.*)

22,697. "Improvements in apparatus for regulating the intensity of electric currents." H. D. Wibratte and A. F. Lanaspeze. Dated October 28th.

22,699. "Improvements in dynamo-electric machines." W. B. Sayers, H. A. Mavor, and Mavor & Coulson, Ltd. Dated October 28th.

22,700. "Improvements in the manufacture of tubes or conduits or the like, more especially intended for containing electric cables or conductors." H. Edmunds. Dated October 28th.

22,728. "Improved means for effecting the collection and transmission of high potential electricity." B. H. Thwaite. Dated October 29th.

22,729. "Improvements in methods having for their object the electrical propulsion of tramway cars and other vehicles, and in apparatus therefor." B. H. Thwaite Dated October 29th.

22,762. "Improvements in the method of and apparatus for indicating and arresting the speed of electric tramway cars and the like vehicles." C. E. B. Holt and A. J. Taylor Dated October 29th.

22,768. "Improvements in methods of and apparatus for increasing the volume of sounds from telephonic or phonographic instruments, and transmitting such sounds to distances." H. L. Short. Dated October 29th.

22,777. "An improved light distributor or reflector for electric incandescence lamps." C. Feldmann. Dated October 29th.

22,794. "Improvements in electric railways or tramways." J. D. F. Andrews. Dated October 29th.

22,799 "New or improved method of and means for switching on and off the electric current in surface contact systems for electrically propelled vehicles and safety 'cut-out' for same or other surface contact systems." F. H. Davies and R. S. Draycott. Dated October 29th.

22,802. "Improvements in or connected with reflectors for incandescence electric and other lamps." L. J. Steele, Sir J. B. Maple, Bart., and J. Verity. Dated October 29th.

22,803. "Improvements in or connected with incandescence electric lamps." L. J. Steele, Sir J. B. Maple, Bart., and J. Verity. Dated October 29th.

22,805. "Improvements in arc lamps and in carbons for same." T. C. J. Thomas. Dated October 29th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

13,735. "Improvements in primary batteries." W. Rowbotham. Dated June 3rd, 1897. Relates to batteries of the kind described in Specification No. 2,378, 1897, in which the separate cells are arranged in steps and the liquids circulate through them from the uppermost to the lowest. The positive electrode may be iron, and the liquid in contact with it is water, and the cock of the water cistern is connected with a switch in such a manner that when the switch is operated to break the battery circuit, the cock is opened, and a stream of water flows through the battery so as to prevent local action on open circuit. 1 claim.

21,249. "Method of, and apparatus for, preventing the sticking, through leakage currents or the like of electric railway section switches." J. G. Lorrain. Dated September 16th, 1897. (The Esmond International Electric Traction Company.) Relates to the sticking through leakage currents of electric railway section switches and consists in providing for that purpose what may be termed leakage plates. These leakage plates are masses of conducting material which lie on the surface of the road. They are placed at any convenient part of the track, but is essential that they should be placed electrically nearer to a rail than are the working sections. The leakage plates are electrically connected to the section switches at a part thereof which, electrically speaking, is situated between the switch coil and the part at which contact with the supply conductor is made and broken. 12 claims.

25,434. "Improvements in trolley wire hangers, for use in overhead lines of electrical railways or tramways." P. Dawson. Dated November 2nd, 1897. Relates to improvements in the construction of trolley wire hangers for overhead lines in electric railways. The hanger is made in one piece for one, two or more overhead line wires which can readily be attached to span wires or bracket arms, and in which the wires are more easily inserted in or removed from their insulators. 4 claims.

28,839. "Improvements in trolleys used on overhead wires for electric traction." W. Wood. Dated December 7th, 1897. Relates to improvements in trolleys, and consists in making the plates which carry the trolley with a double flange at the base projecting beyond all the wearing parts to protect them as they pass over the wires or insulators. The insulators of the trolley pole is also secured by covering it with a hat of mica, &c. In order to take up the wear of the ball race, the adjusting screws with fine threads and chases cut in the opposite sides of the nuts to receive each end of a collar pin inserted in the spindle, whereby a fine and reliable adjustment is obtained. 3 claims.

30,447. "Improvements in supplying electrical energy to railways worked by alternating currents." Siemens Bros. & Co., Limited. (Siemens & Halske.) Dated December 23rd, 1897. Refers to railways worked by alternating currents, and consists in providing those parts of the line requiring a small expenditure of energy with conductors adapted to supply only single-phase currents to the motors on the cars, while to those parts of the line where a large expenditure of energy is required, supply conductors are provided which are adapted to be fed with polyphase currents either from the main supply station, or from special transformers provided along the line. 1 claim.

1898.

22,717. "Improvements in interrupter for electrical circuits, more particularly applicable to induction coils." C. E. S. Phillips. Dated August 4th, 1898. Interrupters for induction coils are constructed with two bodies of mercury constituting the contacts. These are brought together and separated from each other at the required intervals, instead of employing one mercury and one solid metal contact. 3 claims.